*User's Manual*

*Part A - Functions and Features*

# SIMPROCESS

**Release 5**

CACI

EVER VIGILANT

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# *Organization of the SIMPROCESS Documentation Set*

The SIMPROCESS documentation set consists of four manuals:

- *Getting Started With SIMPROCESS*
- *SIMPROCESS User's Manual*
- *SIMPROCESS Metadata Manual*
- *SIMPROCESS OrgModel Manual*

All of the manuals can be opened directly from the **Help/SIMPROCESS Manuals** menu. Also, each manual includes this section which provides links to the chapters in every manual. Press the Control key when clicking any link to open the linked file in a new window. For Windows systems, in order for links between manuals to work properly, Adobe Acrobat or Acrobat Reader must be used to view the manuals.

## *Getting Started*

The *Getting Started With SIMPROCESS* manual is a must for first time SIMPROCESS users. This manual can also be used for evaluation purposes. The chapters are

- Business Process Modeling With SIMPROCESS
- Installation

- Building Your First Model With SIMPROCESS
- Evaluating Alternatives With SIMPROCESS
- Demonstration and Reference Models

## *User's Manual*

The *User's Manual* is divided into four parts with each part being a separate file. Part A is an excellent reference for beginners and casual users. This part contains detailed documentation of the basic and intermediate functions of SIMPROCESS. The chapters are

- Process Modeling and Analysis with SIMPROCESS
- SIMPROCESS Basics
- Statistical Modeling Constructs
- Activity Modeling Constructs
- Resource Modeling Constructs
- Graphical Modeling Constructs
- Activity-Based Costing
- Statistical Output Reports

Part B is a reference intended for advanced users of SIMPROCESS. This part contains detailed documentation of the programming and library management functions in SIMPROCESS Professional Edition. The chapters are

- Reusable Templates and Libraries
- Customizing a Model with Attributes and Expressions
- More Advanced Model Building
- Exporting Results

Part C describes the integrated tools included with SIMPROCESS Professional. The chapters are

- Advanced Data Analysis
- SIMPROCESS Database
- Experiment Manager
- OptQuest for SIMPROCESS
- SIMPROCESS Dashboards
- Model Bundles
- Custom Reports
- Scenarios

The Appendices are

- Importing Version 2.2.1 Models
- Activity Summary Table
- SIMPROCESS File Structure
- Statistical Distributions
- Statistical Tools Glossary
- SIMPROCESS System Attributes and Methods
- External Event Files
- Simulation Results File
- UML Interfaces
- Running Models Without GUI
- SIMPROCESS and External Java Classes

## *Metadata Manual*

The Metadata Manual describes how to build and edit SIMPROCESS metamodels, assign metamodels to a SIMPROCESS model, and enter metadata in a SIMPROCESS model. The chapters are

- SIMPROCESS Metadata
- SIMPROCESS Metamodel Editor
- Assigning Metamodels
- Entering Metadata
- BPEL Metadata

## *OrgModel Manual*

The OrgModel Manual describes how to build and edit SIMPROCESS Organization and Resource Models (OrgModels) and assign OrgModels to a SIMPROCESS model. The chapters are

- SIMPROCESS Organization and Resource Models
- SIMPROCESS OrgModel Editor
- Assigning OrgModels
- Using OrgModels with SIMPROCESS

CHAPTER 1

# *Process Modeling and Analysis with SIMPROCESS*

The goal of Process Modeling is to create a simplified but useful model of a business enterprise. The enterprise can be a small work group or development team, a particular division, a related set of departments, or even an entire company. The model allows an analyst to study the Processes in a business in order to:

- Determine bottlenecks or wasted effort
- Devise revisions to the Process to correct performance problems
- Select Process designs that give the best results
- Provide cost justification
- Establish performance targets for the new Process implementation.

Many types of tools and techniques are available for Process Modeling. Frequently, a simple diagram or flowchart can expose the obvious redundancies, unnecessary work, and inefficiencies in a given Process. Tools which provide simple diagramming of a Process are called *static modeling tools*. However, to expose less obvious bottlenecks and costs intrinsic to the Process requires information about the resources employed in the Process, measurements of the Processing capacity of the resources, and some measure of the expected workflow through the Process.

Many Process modeling tools today do not allow a quantified analysis of the Process under study. Some of those do not take into account the:

- Time-varying nature of many Processes
- Non-linear interactions among elements of a Process
- Random behavior of most real Processes
- Unexpected events in the business environment

The bottom line is that most Processes are not well characterized by deterministic, mathematical models. A dynamic business Process modeling tool, which can simulate the behavior of the Process as it responds to the events occurring in the business environment, is required to analyze time-varying business processes.

### *Why Dynamic Modeling?*

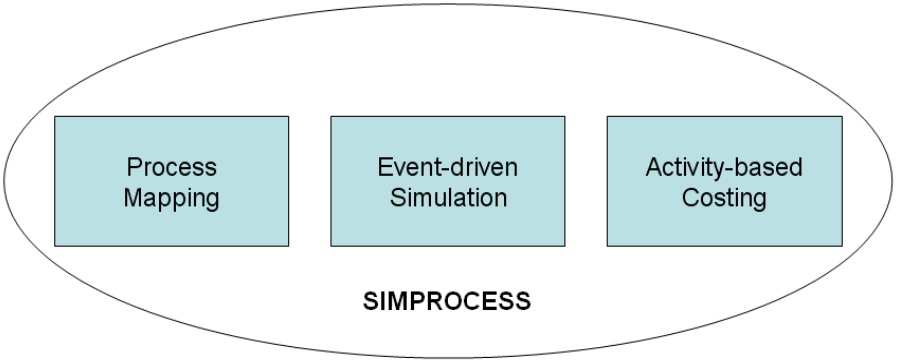
A computerized dynamic model simulates the flow of materials and information through the Process. The dynamic model accounts for the random variations in how work is done and the way materials (and information) flow through the real world. Simulation offers several advantages over a simple pictorial abstraction of a business Process. SIMPROCESS employs discrete event simulation to capture the time-varying nature of the Process under study.

SIMPROCESS advantages include:

- First, the analyst can correlate the data produced by the model with measurements taken from the real Processes to increase certainty that the model has adequately captured the essential features of the real Process.
- Second, the model will generate quantified Process measurements such as: excess capacity or bottlenecks, the time it takes work items to flow through the Process, and the percentage of time expended in value-adding Processes versus non-value-adding Processes.
- Third, the model allows the analyst to evaluate, in quantified terms, the effects of re-engineering the Process.

# What is SIMPROCESS?

SIMPROCESS is a hierarchical and integrated Process simulation tool that radically improves your productivity for Process modeling and analysis. SIMPROCESS is designed for BPR and IT professionals of industrial and service enterprises that need to reduce the time and risk it takes to service customers, fulfill demand, and develop new products.




SIMPROCESS integrates Process mapping, hierarchical event-driven simulation, and Activity-based costing (ABC) into a single tool. The architecture of SIMPROCESS provides an integrating framework for ABC. The building blocks of SIMPROCESS are Processes, resources, entities (flow objects), activities, ABC, and dynamic Process analysis. ABC embodies the concept that a business is a series of inter-related Processes, and that these Processes consist of Activities that convert inputs to outputs. The modeling approach in SIMPROCESS manifests this concept and builds on it by organizing and analyzing cost information on an Activity basis.

# How Do You Use SIMPROCESS?

SIMPROCESS allows you to create an abstract model of a Process under study. You produce a computer model of a business Process and documentation (diagrams and descriptions).

SIMPROCESS is a *dynamic modeling tool* that simulates the flow of entities through the defined Process. Entities could be:

- proposals
- orders
- invoices
- customers
- work-in-Process
- patients.

Entities that a Process receives, acts upon, or produces should be included in the definition of the business Process. Entities flow from one Process step to the next and at each step some task is performed. The Resources, such as people, machines, or information required to complete the tasks are also included in the business model.

SIMPROCESS generates valuable information about the Activities, Entities, and Resources in the model. This data is used to validate the Process model. The generated statistics and reports are used to determine where the Process could be improved. SIMPROCESS allows you to evaluate alternatives and different management policies. SIMPROCESS helps a team decide which changes to a business Process will provide the most benefits.

# SIMPROCESS Editions

SIMPROCESS has four editions:

- Professional Edition - contains all the features and capabilities of SIMPROCESS. There are no limits on model size for models built with SIMPROCESS Professional Edition.
- University Edition - also contains all the features and capabilities of SIMPROCESS. However, model sizes are limited to no more than 50 Processes and Activities.
- Demonstration Edition - models are limited to no more than 25 processes and activities, 5 entity types, and 5 resource types. Also, none of the advanced features are accessible.
- Runtime Edition - contains all the features and capabilities of SIMPROCESS except the ability to save. There are no limits on model size, but models built or modified in this edition cannot be saved.

# SIMPROCESS Terminology and Menus

## *SIMPROCESS Terminology*

This manual uses the following words and definitions in its description of SIMPROCESS.

***Activities***. An Activity is a basic step in a model where an operation is performed on an Entity. Examples of Activities are Generate, Delay, and Dispose. An Activity may or may not involve passage of time or Resource requirements.

***Attributes*** are system and user-defined variables of model elements whose value can change during the course of a simulation run. Attributes may be used to alter the behavior of a Process by changing their value during a simulation. They can also be used to communicate information (such as system time) between two Processes in a model or store data collected during a simulation run.

***Connectors*** link Activities and Processes together and are paths used by Entities to flow through the model. Connectors can have delay times.

***Cycle time***. An Entity's cycle time is the sum of the Processing times and delays it encounters as it is processed in the model.

***Entities*** represents people, goods, or information. Most are produced as a result of a Process or Activity.

Entities are generally created at the Generate Activity, although other Activities (e.g., Batch, Assemble) may produce Entity instances as well. Entities must enter a Dispose Activity to ensure statistics collection.

***Hierarchical Processes***. The concept of a Process provides hierarchical modeling capabilities. A Process is a collection of Activities and sub-Processes organized as a model network.

***Layout*** contains graphical representations of the Activities, Processes, and Connectors that make up a SIMPROCESS model. The Entities only appear on the layout while the simulation is running. The layout can be made to resemble the physical layout of a system, or it can be closer in appearance to a flow diagram.

***Model*** is a representation of the system being studied. It is not intended to be an exact duplicate of the system, but rather a simplified version that captures the relevant features.

***Pads*** are small triangular graphic objects located along the border of an Activity or Process. Pads are used for attaching Connectors to the inputs and outputs of the Activity/Process. Entities enter and exit Activities through input and output pads.

***Alternative Process/Sub-Process***. Alternative Processes define alternative behaviors or flows of a

Process. Multiple alternatives can be associated with a Process, but only one can be active at a time.

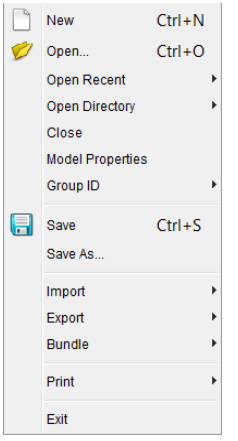
***Resources*** are the agents required to perform an Activity. People, computers, and trucks are all examples of Resources. Resources may be consumable (e.g., oil or paper) or reusable (e.g., trucks).

***Simulation*** is defined as the reproduction of the dynamic and random behavior of a business Process with the goal of quantifying some key characteristics of the business Process.

***Templates*** of Activities, Processes, and Resources can be stored in a Library for reuse.

## SIMPROCESS Menus

## File Menu




**New** creates a new model file.

**Open** loads a previously saved model. If the model directory (see **Save As...** below) does not exist, it is created during the **Open** process.

**Open Recent** contains a list of recently opened models. The first item is **Clear Menu**, which removes all recently opened models from the **Open Recent** menu.

**Open Directory** is a list of SIMPROCESS file directories (**Installation**, **Working**, **Models**, **Metamodel**, **OrgModel**, and **SPUser**). Selecting a directory opens the system file explorer to that directory.

**Close** closes the active model.

**Model Properties** opens a dialog that tracks the edit history of a model.

**Group ID** controls the **Group ID** of a model. There are two sub menu items:

- **Assign Group ID**
- **Clear Group ID**

**Assign Group ID** will be enabled if no **Group ID** is assigned to the model; if one is assigned, **Clear Group ID** will be enabled. No dialog is displayed by either action. If used, the **Group ID** is created internally by SIMPROCESS. Assigning a **Group ID** facilitates collaborative work on a model using a master model and templates placed into a Library. (See "Reusable Templates and Libraries" for more information on templates and Libraries.)

When a model is saved, SIMPROCESS assigns it an internal model ID. Each time a Process or Activity is added from a template in a Library, the model ID is checked against one stored with the template to determine whether the template was originally created from that same model. If it was, the creation of Attributes, Resources, Entities and other items is suppressed based on the presumption that they will already be present in the model. Each time a copy of a model is saved using the **Save As** command, the internal model ID is changed. Saving a copy of the model to another name to give to team members involved in collaborative model development is therefore not ideal. Any templates they might create from the copy would not share the model ID of the original. This results in duplication of Attributes, Resources, Entities and other items into the master model when the team member's efforts are merged back into it via Library templates. The **Group ID** identifies models created with **Save As** as belonging to the master model (using **Assign Group ID** on an open model causes that model to become a master model). **Save As** does not change the **Group ID**. Thus, if the master model has a **Group ID** assigned, every copy of the master model made via **Save As** will carry the same **Group ID**. When a template is placed into a Library from any Process or Activity, the **Group ID** will be stored in the template along with the model ID. When a template is added to a model, the **Group ID** is checked before the model ID to avoid duplication of Attributes and other items. Only if no **Group ID** is present in the model or if the **Group ID** of the model and the **Group ID** of the template do not match will the model ID check be performed.

**Save** saves the model. Saving a model that has not previously been saved will execute **Save As...** so the model can be named.

**NOTE:** It is a good idea to save a model any time you make changes to it and to save a model under a different name any time you extensively change a model. SIMPROCESS saves your models with the extension `.spm` and at the same time also saves a backup with the extension `.bck`. To save a new model or to save an existing model under a new name, use **File/Save As...**. For information on automatic saving, see "Other Preferences" on page 33.

**Save As...** is used to save a model for the first time, or to save a model with a new name. **Save As...** creates a directory for the model (referred to as the model directory) that has the model name without extension and is in the same directory as the model file. The model directory is the default location

for input and output files of various types and is the preferred location for imported images (see "Importing Graphics Image Files") and external Java classes (see "SIMPROCESS and External Java Classes"). Note that when performing **Save As...** the complete contents of the previous model directory are copied to the new model directory.

#### Import

**Version 2.2.1 Model...** imports a SIMPROCESS version 2.2.1 or 2.2.2 model. Due to changes in the graphical coordinate system from earlier versions of SIMPROCESS to the current version, some cleanup will be required. See "Importing Version 2.2.1 Models" for more information.

**XPDL Model...** imports an XPDL model. (See http://www.wfmc.org for information on XPDL.) The XPDL model will be validated against the XPDL 2.2 schema. A copy of this schema can be found at http://www.wfmc.org/standards/docs/bpmnxpdl_40a.xsd. Validation errors may occur if the XPDL model is based on XPDL 2.0 or earlier. If SIMPROCESS indicates there are validation errors, simply continue with the import. Most likely the validation errors are due to a difference in XPDL versions instead of malformed XPDL.

Not all elements of an XPDL model are imported to SIMPROCESS. The following table shows the XPDL elements that are imported and their corresponding SIMPROCESS constructs.

| XPDL Element | SIMPROCESS Construct |
|---|---|
| WorkflowProcess | Process |
| ActivitySet | Process |
| Activity | Activity |
| Transition | Connector |
| DataField | Global Entity Attribute |
| FormalParameter | Global Entity Attribute |
| Performer | Resource |
| Artifact | Entity Type |
| SimulationInformation/ TimeEstimation/Duration | Activity Delay Time |

For XPDL 1.0, if x-y coordinates for Activity elements are to be imported, they must be in an `ExtendedAttribute` element with the attribute `Name` set to **Coordinates**. The child element containing the x and y values must have the attributes `xpos` and `ypos`. The name of the child element does not matter. For XPDL 2.0 and higher, x-y coordinates are determined from the `NodeGraphicsInfo` element. Below is an example of an XPDL 1.0 Activity that includes coordinates.

```
- <Activity Id="9">
   <Route />
 - <TransitionRestrictions>
  - <TransitionRestriction>
   - <Split Type="AND">
    - <TransitionRefs>
       <TransitionRef Id="1" />
       <TransitionRef Id="38" />
       <TransitionRef Id="2" />
      </TransitionRefs>
     </Split>
    </TransitionRestriction>
   </TransitionRestrictions>
-  <ExtendedAttributes>
-   <ExtendedAttribute Name="Coordinates">
     <xyz:Coordinates xpos="572" ypos="389" />
    </ExtendedAttribute>
   </ExtendedAttributes>
  </Activity>
```

The type of SIMPROCESS activity that is created is based primarily on whether or not a `Route` element exists as a child of the `Activity` element. If there is no `Route` element, then the corresponding SIMPROCESS activity is a Delay activity. If there is no `Route` element and there is an `Implementation/SubFlow` element, the corresponding SIMPROCESS Activity is a Process. Other factors concerning `TransitionRestrictions` come into play when determining other types of SIMPROCESS Activities. As an example, the `Activity` element above would result in a Split Activity in SIMPROCESS. This is because there is a `Split` element within a `TransitionRestriction` element that has a `Type` of `AND`, and there is more than one `TransitionRef` element.

Note that if the XPDL model being imported was previously exported from SIMPROCESS 4.3 or higher, the model may contain some SIMPROCESS unique information that will help appearance. If the XPDL model was previously exported from SIMPROCESS 5.1 or higher, the model will contain SIMPROCESS unique simulation information. During import, if SIMPROCESS detects unique information from other applications, this information will be transferred to the new SIMPROCESS model. Thus, if the SIMPROCESS model is later exported to XPDL, that application unique information will be exported as well.

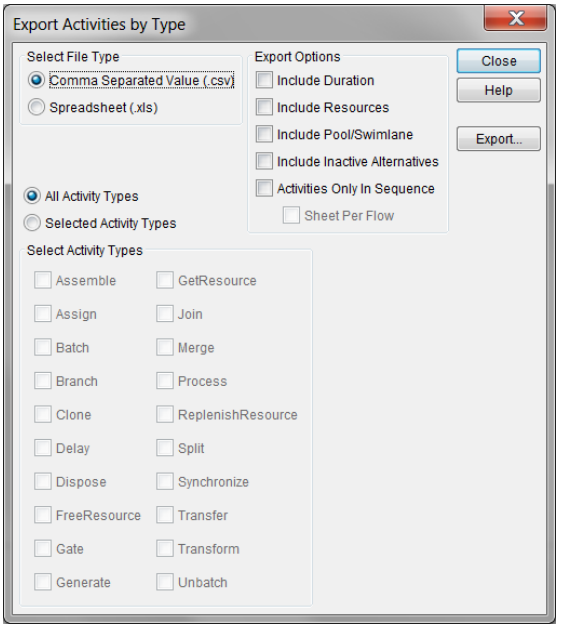
**MS Project File...** imports a Microsoft Project file (`*.mpp`). The resulting model should be considered a starting point for modeling the project detailed in Microsoft Project.

### *Export*

**Graphics Image File...** creates a JPEG image of the current layout.

**Activities** contains two options:

- **Activity List...** outputs the Process and Activity hierarchy to an ASCII file.
- **Activity By Type...** displays a dialog that allows Activities to be output to a comma separated file (`.csv`) or spreadsheet file (`.xls`). **Comma Separated Value (.csv)** is the default file type. The output is the same no matter the type of file selected except for the **Sheet Per Flow** option, which is described below.

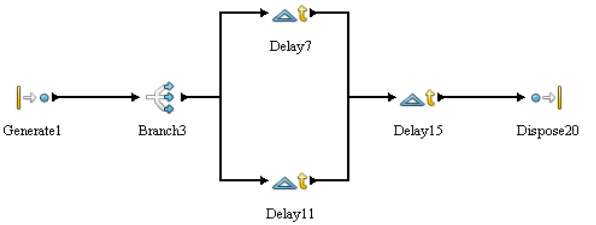



**All Activity Types** is the default option for the types of Activities to export. If only certain Activity types should be exported then select **Selected Activity Types**. When this option is selected, the Activity types listed under **Select Activity Types** enable. This allows the export of Activities to be restricted to certain types of Activities.

The columns included in the exported file are **Parent Process Number**, if **Show Process Numbering** is selected on the **View** menu (see "View Menu" on page 56), **Parent Process** (the name of the parent Process of the Activity), **Alternative** (the name of the Process Alternative of the Activity), **Activity** (the name of the Activity), and **Activity Type** (the type of the Activity). If the Activity or Process is on the top layout, the **Parent Process Number** column (if included), **Parent Process** column, and the **Alternative** column will

be empty. The **Export Options** are

1. **Include Duration** - Adds **Duration** and **Time Unit** columns which contain the selected duration distribution and selected duration time unit for the Activity. If the Activity cannot have a duration there are no values for these columns.
2. **Include Resources** - Adds a **Resources** column which contains the Resources assigned to the Activity. If there are multiple Resources assigned they are listed separated by a comma. Each assigned Resource is followed in parentheses by the number of units requested. For example, if one unit of Resource1 was required the column would contain Resource1(1.0). If there are no Resources assigned or the Activity cannot have Resources assigned there is no value for this column.
3. **Include Pool/Swimlane** - If there are Pools defined in the model two columns are added, **Pool** and **Swimlane**. If only Swimlanes are defined in the model then only a **Swimlane** column is added. An Activity or Process is considered to be in a Pool or Swimlane if it is totally contained within the Pool and/or Swimlane. If any portion of the Activity or Process is outside of a Pool and/or Swimlane the **Pool** and/or **Swimlane** columns will be empty.
4. **Include Inactive Alternatives** - Adds Activities and Processes from inactive as well as active Alternatives. When it is not selected only active Alternatives will be considered. (See "Alternative Sub-Processes" on page 101 for more information on active and inactive Alternatives.) This option adds a column at the beginning called **Parent Process Path**. This is needed since simply listing the parent Process name and parent Alternative name will not always fully identify which Activity is referenced.
5. **Activities Only In Sequence** - Orders the list of Activities following the flow from each Generate Activity. Processes are excluded. This option adds two columns, **Activity ID** and **Predecessor ID**. The **Activity ID** column contains a numeric (or alphanumeric) identification number for each Activity. Since there is only one list of Activities, the list begins with the first Generate Activity and follows the flow until a Dispose Activity is encountered or a loop is encountered that repeats the flow. However, there may be multiple paths within the flow due to Branch, Split, or other Activities. The export will follow one path to the end then go back and add other paths. Each Activity will have one or more values in the **Predecessor ID** column. This shows which Activities precede this Activity. Note that this path may not terminate with a Dispose Activity since Activities will not be duplicated in the export. Consider the simple model below.




The export will start with Generate1 and then include every Activity following until Dispose20 is reached. However, Delay11 will not be included. It will be added after Dispose20 but the Predecessor ID value will be the Activity ID of Branch3. Also, notice that Delay15 and Dispose20 are not repeated. See the export below.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Parent Process | Alternative | Activity | Activity Type | Activity ID | Predecessor ID |
| 2 | | | Generate1 | Generate | 1 | None |
| 3 | | | Branch3 | Branch | 3 | 1 |
| 4 | | | Delay7 | Delay | 7 | 3 |
| 5 | | | Delay15 | Delay | 15 | 7, 11 |
| 6 | | | Dispose20 | Dispose | 20 | 15 |
| 7 | | | Delay11 | Delay | 11 | 3 |

When **Spreadsheet (.xls)** and **Activities Only In Sequence** are both selected, **Sheet Per Flow** is enabled. This can be a better option to examine every Activity flow. This option creates a sheet for every unique flow in the model. The list on each sheet begins with a Generate Activity (or Receive Transfer Activity that has no associated Send Transfer Activity) and follows the flow until a Dispose Activity or Trigger Pad is encountered or a loop is encountered that repeats the flow. Depending on the size of the model and the number of path options, this could result in a spreadsheet with many sheets. For example, the simple demonstration model `CallCenter.spm` has 11 unique flows so exporting that model with these options selected results in a spreadsheet with 11 sheets. Each sheet is named based on the name of the Generate Activity that starts the flow. If the Generate activity is not on the top layout, the parent Process and Alternative names are included. (Note that Excel limits a sheet name to a maximum of 31 characters so the sheet names are adjusted accordingly. Thus, if a sheet name error occurs, shorten the Activity, parent Process, or parent Alternative name.) Each flow from a Generate Activity is numbered starting with one. The same model exported with these options creates two sheets: Generate1_1 and Generate1_2. Since each sheet has a complete flow there are no **Activity ID** and **Predecessor ID** columns.

**UML Activity Model** outputs the model to a UML-compatible file. This feature is disabled in the SIMPROCESS Runtime version. See "UML Interfaces" for more information.

**XPDL Model** outputs the model to an XPDL 2.2 compatible file that follows the schema at http://www.wfmc.org/standards/docs/bpmnxpdl_40a.xsd. (See http://www.wfmc.org for information on XPDL.) Exported XPDL models will contain some SIMPROCESS unique information. This information is only useful to SIMPROCESS and should be ignored by other applications importing the model. The table below shows how SIMPROCESS model constructs export to XPDL.

| SIMPROCESS Construct | XPDL Element |
|---|---|
| Process | WorkflowProcess |
| Activity | Activity |
| Entity Type | Artifact |
| Resource | Performer |
| Attribute | DataField |
| Connector | Transition |
| Branch Connector | Transition/Condition |
| Activity Delay Times | SimulationInformation/ TimeEstimation/Duration |
| Swimlanes | Pools/Pool/Lanes |

**BPEL Process** creates an XML file that contains a Business Process Execution Language (BPEL) process constructed from SIMPROCESS metadata. See the *SIMPROCESS Metadata Manual* for more information.

**Ultimus** creates an XML file compatible with the Ultimus XML Converter. The XML file is created in the model's directory, and the name of the file consists of the name of the model followed by `_Ultimus.xml`. The Ultimus XML Converter uses that XML file to create an Ultimus file (`.wfl`) for use in Ultimus BPM Studio. See www.ultimus.com for more information on Ultimus.

**Workpoint** creates an XML file that can be used to create a WorkPoint archive file. The WorkPoint archive file can be imported into WorkPoint to produce a WorkPoint process. The XML file is created in the model's directory, and the name of the file consists of the name of the model followed by `_WorkPoint.xml`. Note that a WorkPoint process created from a SIMPROCESS model contains minimal information and is merely intended to provide a starting point from which to begin implementing an actual WorkPoint work flow. The table below shows the mapping of SIMPROCESS Activities to WorkPoint objects.

| SIMPROCESS | WorkPoint |
|---|---|
| Assemble | Activity |
| Assign | Activity |
| Batch | Activity |
| Branch | Optional Delay |
| Clone | Not Applicable |
| Delay | Activity or Delay |
| Dispose | Stop |
| Free Resource | Not Applicable |
| Gate | Delay |
| Generate | Activity |
| Get Resource | Not Applicable |
| Join | Optional Delay |
| Merge | Not Applicable |
| Process | Sub-process |
| Replenish Resource | Not Applicable |
| Split | Optional Delay |
| Synchronize | Activity |
| Transfer | Stop |
| Transform | Activity |
| Unbatch | Activity |

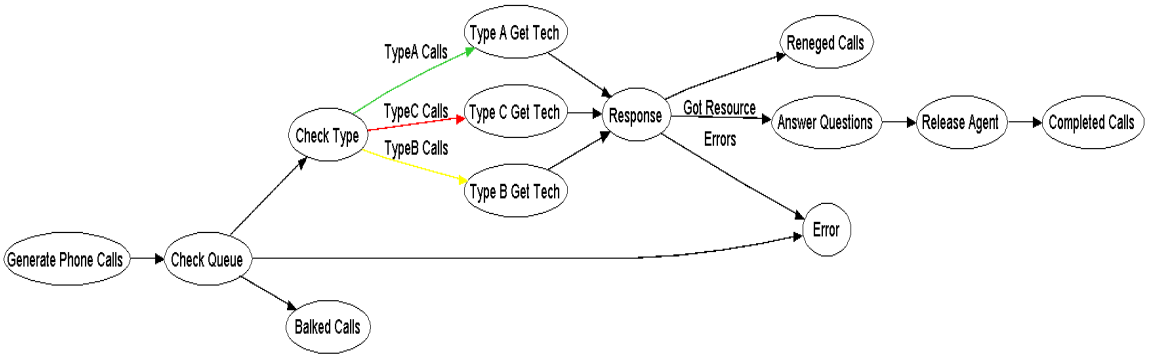
The following table lists the SIMPROCESS data element on the left and the corresponding WorkPoint data element on the right.

| SIMPROCESS | WorkPoint |
|---|---|
| Process Name | Process Name |
| Activity Name | Activity Name |
| Activity Comment | Activity Description |
| Activity Location | Activity Display Info |

| SIMPROCESS | WorkPoint |
|---|---|
| Activity Duration | Activity Planned Duration |
| Delay Duration | Delay Date Offset |
| Connector Name | Transition Name |

- If a SIMPROCESS Connector is a Branch Connector, a dummy Workpoint transition script is generated where the script name is the same as the Connector name and the script description is set to the "Condition" value.
- If a SIMPROCESS Delay Activity specifies Resource usage, a WorkPoint Activity is generated. Otherwise, a WorkPoint Delay node is generated.
- SIMPROCESS Entity definitions can optionally be exported to WorkPoint process user data. The user data name will be the Entity name and the user data value will default to "X".
- SIMPROCESS resources are exported to WorkPoint activity descriptions. If specified, the resources are included in the activity description in the format: "Resource=[resource1],[resource2],...[resourceN]".
- SIMPROCESS does not identify to WorkPoint upstream (or looping) transitions. Therefore, once the model is imported into WorkPoint, the user must locate all upstream transitions and identify them as such by opening the transition properties and setting the appropriate check-box.
- In some cases, the WorkPoint import generates dummy scripts. This means, after the archive file is imported into WorkPoint, the user must edit each of the scripts and set them appropriately.

**Dot Workflow** creates a workflow file using the Dot language that presents a “flat” (non-hierarchical) view of the model. The file is created in the model’s directory, and the file name consists of the model name followed by `_Dot.txt`. The file can be opened in a graph visualizer such as ZRGViewer (http://zvtm.sourceforge.net/zgrviewer.html). Below is a view from ZRGViewer of the CallCenter demo model.




**Publish Model to HTML...** outputs the model to HTML format to be made accessible via a standard web browser. Select a destination directory, and a new directory will be created with the same name as the model (with any spaces replaced by underscores).

All layouts will be exported to JPEG image files with web pages built around them. Lists of the model's Activities, Processes, Resources, Entities, and each type of Global Attribute will be provided, including links to the properties of each. The Standard Report data will be included along with any plots that are available via the Display Real-Time Plots menu item, if the model had been executed.

**Slideshow** creates a slideshow file of the model layouts in the model's directory.

**PDF** creates a `.pdf` file of the model layouts in the model's directory.

**RTF** creates a `.rtf` file of the model layouts in the model's directory.

**MS Project File** creates a `.mpx` (Microsoft Project Exchange) file in the model's directory. Microsoft Project options may need to be changed to allow Project to open this file format. See **Tools/Options** in MS Project. Select the **Security** tab and click **Allow loading files with legacy or non default file formats**. Activity delays in a SIMPROCESS model translate to task durations in MS Project. Since most Activity delays are some form of distribution and not constants, a better export can be obtained by selecting **Collect Activity Statistics** either globally (see "Default Performance Measures" on page 243) or on key Activities and then running the model for multiple replications before exporting. If this is done, during export, Activities that do not have a constant for **Duration** will use the average cycle time across replications (see "Cycle Time by State Statistics" on page 255) for the task time in MS Project. Note that MS Project does not support task times of less than a minute so Activity durations of less than a minute will be zero in the exported MS Project file.

### *Bundle*

**Create** creates a model bundle file. See "Model Bundles" for more information on model bundles.

**Extract** extracts a model bundle file and opens the bundled model (Model Bundles).

### *Print*

**Print Layout…** prints a picture of the current model layout, including background icons, but the layout color will not be printed.

**Print Model…** prints a picture of each screen of the model. The first page is a table of contents.

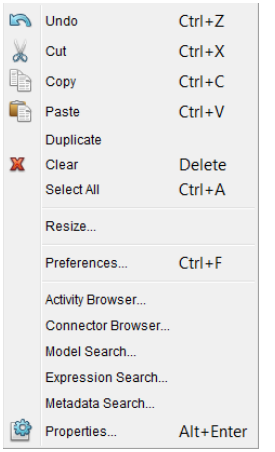
**Process Documentation…** prints the descriptions of selected Processes.

**Model Documentation…** prints the description of all elements of the model. This includes **Name**, **Path,** and **Comment** field entries of all Activities/Processes, Connectors, Entities, and Resources in the model. Any information you have added using the **Document** button is also included.

**List of Most Recently Used Models.** The **File** menu contains a list of the most recently used models. Open any of these models by clicking on its name. The number of recent files is set on the **Edit/Preferences** dialog.

**Exit** quits SIMPROCESS. If you have made edits since you last saved the open models, you will be prompted to save your models before exiting.

## *Edit Menu*




### *Undo*

**Undo** restores Activities, Processes, and Connectors that have been cut or cleared (deleted). It also

reverses Align and Distribute actions, removes Activities, Processes, and Connectors that have been added, and reverses any move Connector actions. The **Undo** is only active at the hierarchical level where the action occurred. A maximum of 30 **Undo** actions can be active at any one time. As editing events occur that create **Undo** actions, the most recent 30 actions are the ones that are kept. The **Undo** menu and the tool tip for the **Undo** button will update to show the next **Undo** action (for example **Undo Clear**, **Undo Cut**, **Undo Align**, **Undo Distribute**). **Undo** actions are active in the reverse order of the editing actions that created them. For instance, if Activities are aligned, then an Activity is deleted, the order of **Undo** actions would be **Undo Clear** followed by **Undo Align**.

### *Cut*

**Cut** cuts the selected object from the model layout. The cut object is copied to the clipboard, and the object may be pasted onto a different part of the layout or into another open model using **Edit/Paste**. Connectors and Pads cannot be cut. They can only be cleared.

### *Copy*

**Copy** places a copy of the selected object in the clipboard. It will remain there until replaced by another object that is cut or copied. Once a copy is made, it can be pasted on the layout or into another model by using the **Edit/Paste** command.

### *Paste*

**Paste** makes a copy of the object in the clipboard and pastes it onto the layout. Multiple copies of an object can be pasted without additional copies being made. Pasting items into a model different from the model where the copy or cut occurred can cause loss of entity, attribute, resource, function, or distribution references. See "Advantage of Templates Over Copy/Paste" for more information.

### *Duplicate…*

**Duplicate…** is a shortcut that copies a selected object from the layout and then does a paste to a position selected on the layout. This combines **Copy** and **Paste** into one command. This is useful when you want to quickly copy something on the layout and paste it somewhere else.

### *Clear*

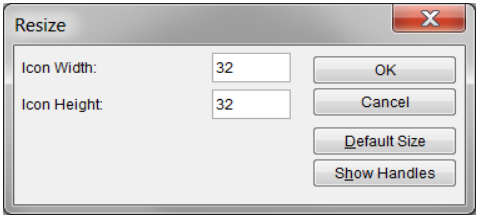
**Clear** deletes a selected object without copying it to the clipboard.

### *Select All*

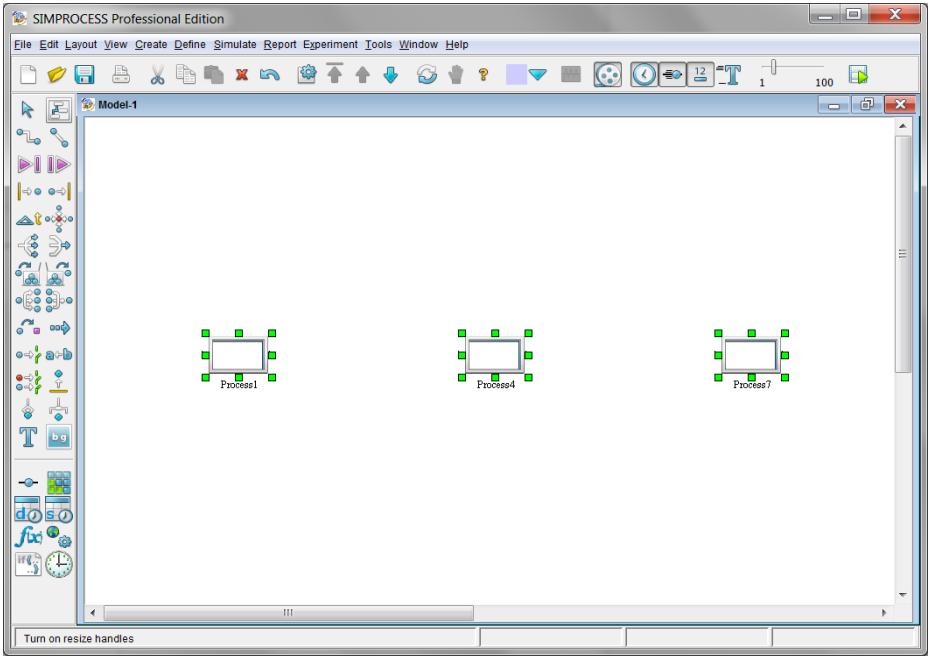
**Select All** selects all objects on the model layout.

### *Resize*

**Resize** lets you resize a layout object. You can resize the horizontal and vertical directions separately if you wish to resize the icon in a non-proportional way. The values represent pixels. The **Default Size** button sets the **Icon Width** and **Icon Height** to the default size of the icon. Choose the **Show Handles** button if you would like to drag to resize the object. Multiple objects can be resized at the same time by having multiple items selected when choosing **Resize**. **Important Note**: An object cannot be resized smaller than 10 x 10 pixels. Thus, if numbers are entered that are smaller, the object will be resized to 10 x 10. Also, Background Text objects cannot be resized using **Resize**. The font properties must be changed to resize Background Text.




The following image shows three processes after **Show Handles** was selected.

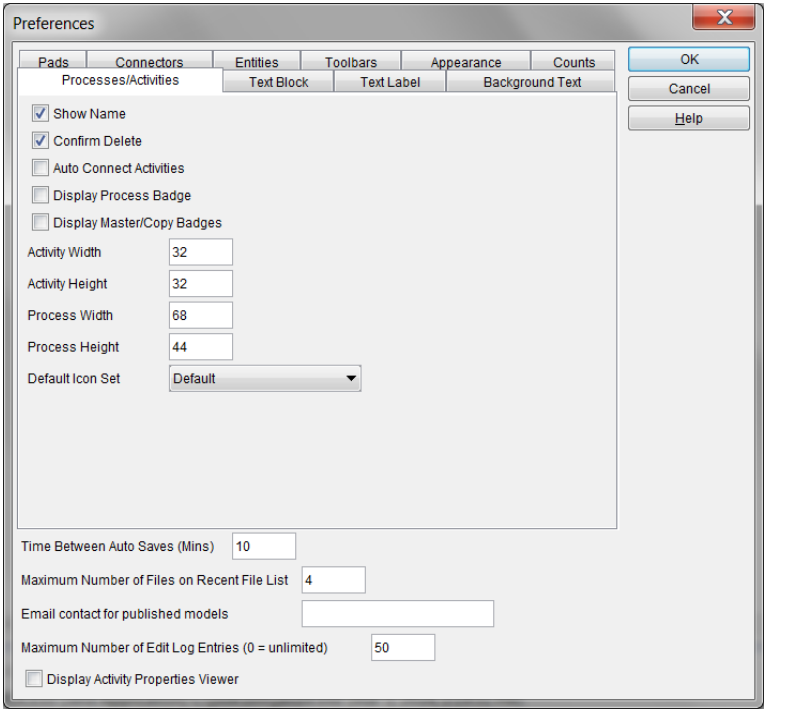


### *Switch Activity To*

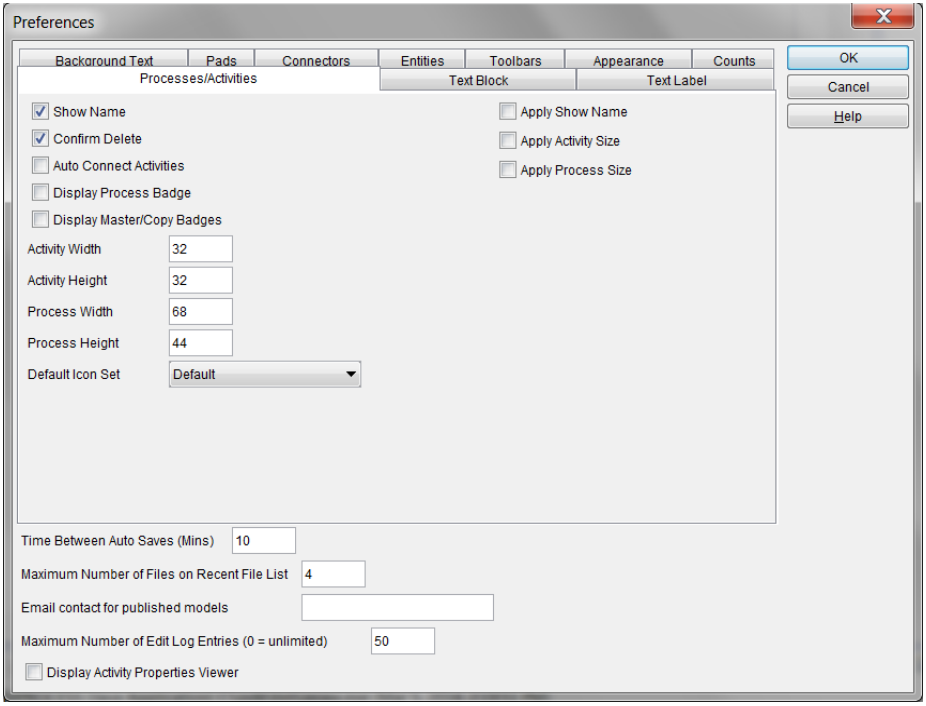
**Switch Activity To** changes an activity from one type to another. This menu item is only displayed when one and only one activity is selected on the layout. Processes do not activate this menu item. Items that are in common between the old activity type and the new activity type are transferred to the new activity. Since some activities allow multiple connections to output pads and some do not, all connections to the old activity may not transfer to the new activity. This menu item also displays on the right mouse click contextual menu.

### *Preferences*

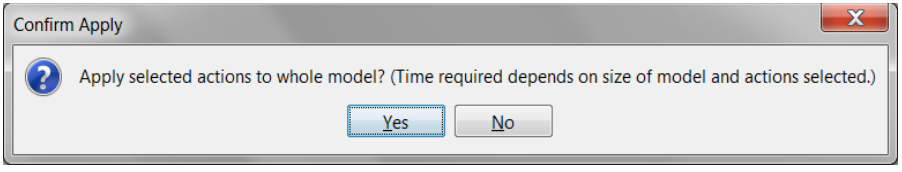
**Preferences** allows the setting of personal preferences for various options in SIMPROCESS. These preferences take effect after the dialog is closed.




If a model is open when the **Preferences** menu item is selected, check boxes appear that allow selection of preferences to be applied to the active model.




**Preferences** selected for application to the active model are applied when **OK** is clicked. Before the selected actions are applied to the active model, a dialog confirming that these actions should occur appears.




If **No** is selected, the active model is not updated. It may take a few minutes to apply updates to a large model. Other editing actions are not allowed while the update occurs. Note that these updates actually change the properties of the active model. The options to display or not display Activity, Pad, and Connector names on the **View** menu do not change the model properties, just what is currently visible. (See page 59.)

There are ten tabs on the Preferences dialog:

- Processes/Activities

- Text Block
- Text Label
- Background Text
- Pads
- Connectors
- Entities
- Toolbars
- Appearance
- Counts

### *Processes/Activities*

**Show Name** specifies to show the name on the layout by default for newly created Activities.

**Confirm Delete** causes a confirmation dialog to appear when you delete an Activity or a Process.

**Auto Connect Activities** causes new activities placed on the layout to automatically connect (if possible) with any previously selected activities. The type of connector to use (**Bent** or **Straight**) is set on the **Connections** tab. This option can also be turned on/off on the right mouse click contextual menu.

**Display Process Badge** causes a small icon (green plus sign) to display on the lower right hand corner of non-empty Processes.

**Display Master/Copy Badges** causes a small icon (letter M for Master Processes and letter C for copies of Master Processes) to display on the lower left hand corner of Processes. (See "Master Processes" on page 103 for more information on Master Processes.)

**Activity Width/Height** sets the default width and height of new Activities.

**Process Width/Height** sets the default width and height of new Processes.

**Default Icon Set** sets the default **Icon Set** for new Activities and Processes.

### *Text Block*

**Show Text Block** displays the text blocks for the Activities on the layout.

The **Font Attributes** set the default **Font Name**, **Size**, **Color**, **Bold** and **Italic**.

### *Text Label*

The Text Label preferences are for text labels that are created from the Text Block of a Process. See "Labeling with Text Blocks," beginning on page 84 for information on how to use these.

**Add Text Label** sets whether the label should be added inside the process for each alternative.

**Horizontal Text Label** sets whether the label should be horizontal (selected) or vertical (not selected) on the layout.

The **Font Attributes** set the default **Font Name**, **Size**, **Color**, **Bold** and **Italic**.

### *Background Text*

The **Font Attributes** set the default **Font Name**, **Size**, **Color**, **Bold** and **Italic**.

### *Pads*

**Show Name** shows the pad names on the layout.

**Confirm Delete** causes a confirmation dialog to appear when you delete a Pad.

**Pad Size** specifies the default size of pads: **Small**, **Medium**, or **Large.**

### *Connectors*

**Show Name** displays Connector names on the layout.

**Confirm Delete** causes a confirmation dialog to appear when you delete a Connector.

**Line Width** specifies the default line width for new Connectors.

**Line Style** specifies the default line style for new Connectors.

**Default Connector for Auto Connect** specifies the type of connector (**Bent** or **Straight**) to use when **Auto Connect Activities** on the **Processes/Activities** tab is selected.

### *Entities*

**Specify Default Icon Size** determines whether new Entity Types will use the values in **Icon Width** and **Icon Height** for the default size of the animation icon. If selected, the default size is applied, not only when an Entity Type is defined, but when the icon for the Entity Type is changed. If the size of the icon is changed while editing the Entity Type, the new size is retained until the icon is changed. When **Specify Default Icon Size** is not selected, the icon size defaults to the default size of the selected icon.

**Default Icon Set** sets the default **Icon Set** for new Entity Types.

### *Toolbars*

The display of the System Toolbar and Model Toolbar is optional.

### *Appearance*

Sets the overall appearance of SIMPROCESS. **System** specifies the default appearance for the operating system. **Metal** and **Nimbus** are other styles. The selection is applied when **OK** is selected.

### *Counts*

Sets the default options for displaying Activity counts. See "Animation Settings…," beginning on page 65 and "Setting Activity Count Options," beginning on page 87.

### *Other Preferences*

**Time Between Auto Saves** determines the approximate amount of time between automatic saves of the model. The automatic save feature creates a file with the same name as the current model, except with an identifier number assigned by the system added along with the extension `.tmp` (for example, `MyModel41123.tmp`). If the current model is new and has not been saved, the name of the temporary file will be the model's assigned name (Model-1, Model-2, etc.) along with an identifier number and a `.tmp` extension and will be located in the models directory.

**NOTE**: The automatic save does not affect the `.bck` file. The `.bck` file is created or updated when you initiate a save. See page 16 for information on the backup file.

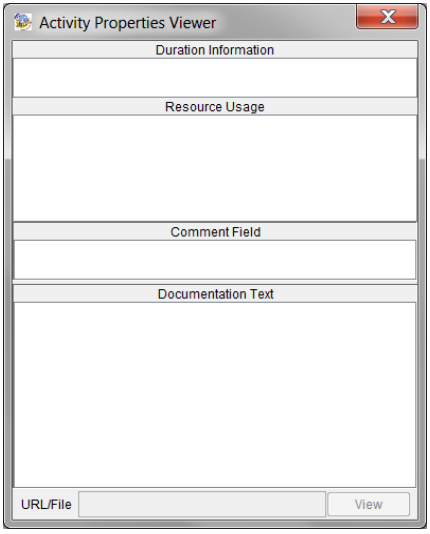
**Maximum Number of Files on Recent File List** sets the number of files on the **File** menu. The default is 4, and the allowable values are 0 through 9.

**Email contact for published models** is where the email address is set that is to be used with models published via the **Publish Model to HTML** feature. If an entry is present, the popup menu that appears in published models when holding the mouse over any Process or Activity will include a "mailto" link with this address having a default subject line containing the complete path to the Activity or Process. This is provided so that viewers can offer feedback or ask questions. This email address is not validated. Note that not all email clients will properly handle the use of the "?subject" portion of a mailto link.

**Maximum Number of Edit Log Entries** sets the limit of entries in the model's edit log. The default is unlimited (0 entry).

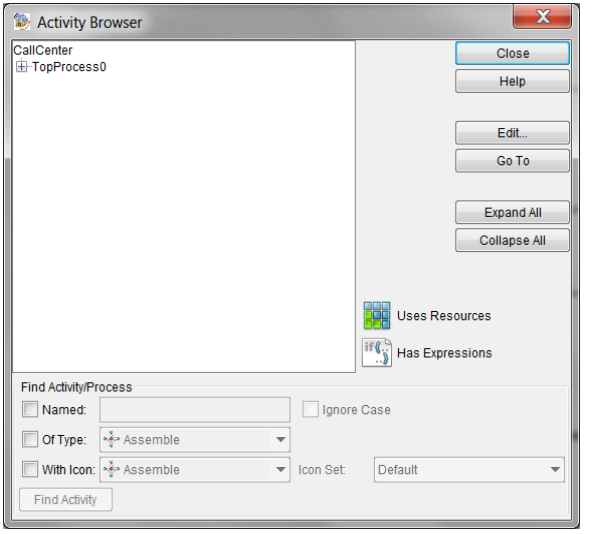
**Display Activity Properties Viewer** toggles the display of the Activity Properties Viewer dialog. This dialog can be resized and remains visible until deselected here or the dialog is closed. Note that closing the dialog will turn off this setting. Selecting any Activity or Process on the layout will display certain Activity and Process properties. When an Activity is selected, the Activity duration in its **Duration** field displays in the **Duration Information** field, and the Resource usage information displays in the **Resource Usage** field. When an Activity or a Process is selected, the text in its **Comment** field displays in the **Comment Field** section, and the text of the **Documentation** displays in the **Documentation Text** section. The **File/URL** field will display the contents of that same field from the **Documentation** tab of the properties dialog for the selected Activity or Process. If enabled, the **View** button will attempt to launch your preferred web browser (for a URL) or suitable application for the file if it contains any path

information. By providing easy access to key Activity or Process properties, this feature is ideal for use in model review and validation. (See “Common Activity Input Fields” on page 81.)

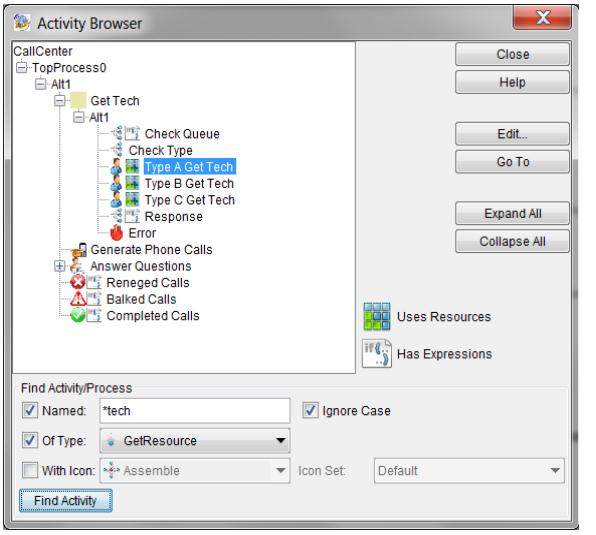



### *Activity Browser...*

**Activity Browser...** is a feature for navigating among the Activities. A dialog lists all the Activities and Processes contained in the model. Any name preceded by a (+) signifies a hierarchical Process or a Process Alternative. Double-clicking on the Process or Process Alternative name will expand the tree diagram, displaying Activities and Processes underneath. Double-clicking on the Activity name will bring up the properties of the Activity. Each item has an icon that identifies the item as an Activity or a Process, and an icon that indicates whether the item has Expressions or Resources. Select an Activity and either **Edit** the Properties of that Activity or **Go To** the layer in the model layout where that Activity resides. **Expand All** expands the complete model hierarchy, and **Collapse All** restores the hierarchy to the top level.

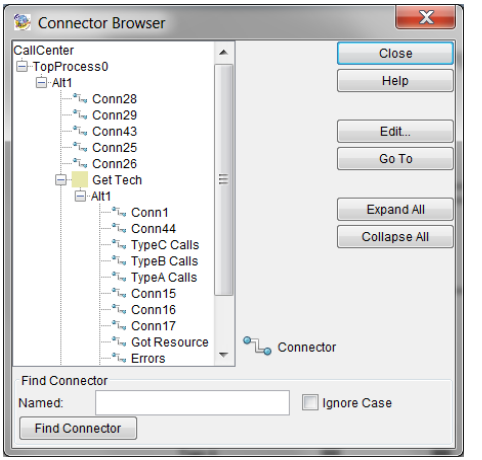



The **Activity Browser** can be used to search for specific Processes or Activities. There are three search criteria: Activity name, Activity type, or Activity icon. Each can be used individually or in combination. Search criteria that are combined are combined using "and" logic. The asterisk (*) can be used as a wildcard for name searches. The asterisk can go at the beginning of the search string, the end of the search string, or both. Wildcards cannot be used in the middle of a search string. Select **Ignore Case** to perform case insensitive searches. Selecting **Find Activity** finds the first Activity in the model hierarchy that matches the search criteria. Subsequent clicks of **Find Activity** will continue the search for the next match.




### *Connector Browser...*

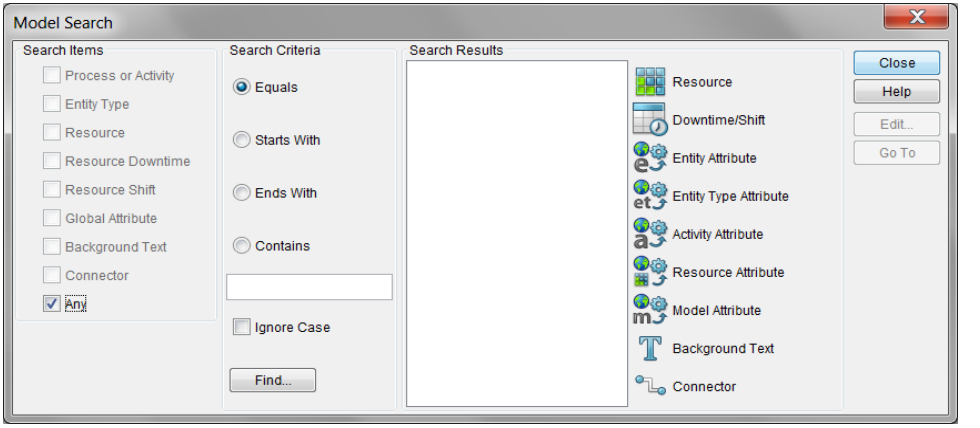
**Connector Browser...** is a feature for navigating among the Connectors. A dialog lists all the Processes and Connectors contained in the model. Any name preceded by a (+) signifies a hierarchical Process or a Process Alternative. Double-clicking on the Process or Process Alternative name will expand the tree diagram, displaying Connectors and Processes underneath. Double-clicking on the Connector name will bring up the properties of the Connector. Each item has an icon that identifies the item as a Connector or a Process. Select a Connector and either **Edit** the Properties of that Connector or **Go To** the layer in the model layout where that Connector resides. **Expand All** expands the complete model hierarchy, and **Collapse All** restores the hierarchy to the top level.



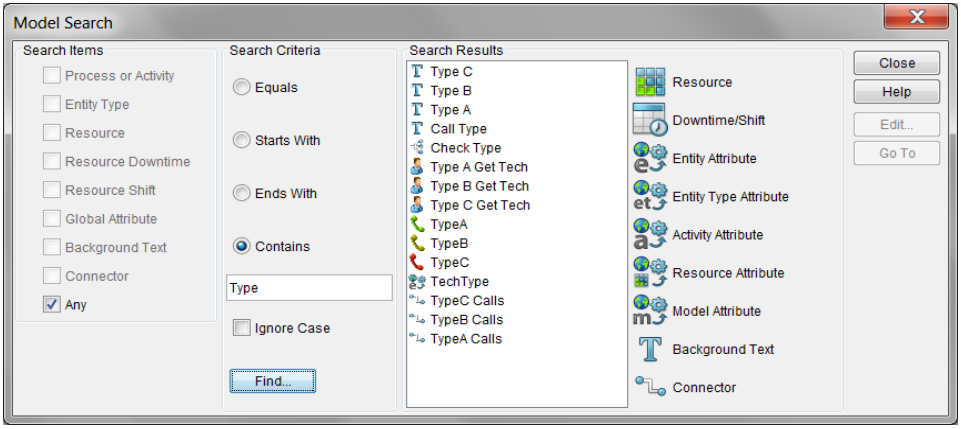

The **Connector Browser** can be used to search for specific Connectors by name. The asterisk (*) can be used as a wildcard for searches. The asterisk can go at the beginning of the search string, the end of the search string, or both. Wildcards cannot be used in the middle of a search string. Select **Ignore Case** to perform case insensitive searches. Selecting **Find Connector** finds the first Connector in the model hierarchy that matches the search criteria. Subsequent clicks of **Find Connector** will continue the search for the next match.

### *Model Search...*

**Model Search** is a quick way of searching by name for items within the model. The **Model Search** dialog has three areas: **Search Items**, **Search Criteria**, and **Search Results**.



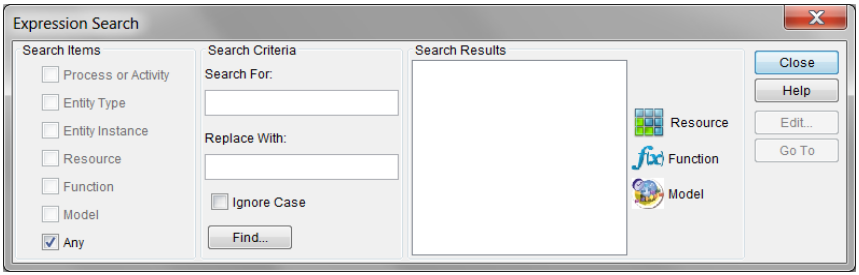
**Search Items** has nine check boxes: **Process or Activity**, **Entity Type**, **Resource**, **Resource Downtime**, **Resource Shift**, **Global Attribute**, **Background Text**, **Connector**, or **Any** (default). The other items become available for selection when **Any** is deselected. **Model Search** searches the names of the selected **Search Items** based on the options set in **Search Criteria**. Enter the string to search for in the text field of **Search Criteria**, then select how to compare the string entered with the names of the selected **Search Items**. The options are **Equals**, **Starts With**, **Ends With**, or **Contains**. Select **Ignore Case** to perform a case insensitive search. Once the **Search Criteria** has been set, click the **Find...** button to perform the search. **Search Results** displays the items found. The type of each item found (Process or Activity, Entity Type, Resource, Global Attribute, Background Text, or Connector) is identified by an icon to the left of the name. Process, Activity, or Entity Type items display a scaled down version of their assigned icons. Resource, Global Attribute, Background Text, or Connector display an icon based on the legend to the right of the list. The example below shows a search on the `CallCenter.spm` demonstration model. The search was a case sensitive search for any names containing **Type**. Four background text items, four activities, three entity types, one global entity attribute, and three connectors were found.




Selecting an item will cause the **Edit...** button to activate. The properties of the item can be edited by clicking the **Edit...** button or by double-clicking an item. The **Go To** button will activate if the item selected is a Process or Activity. Selecting **Go To** will take you to the level of the model where that item is located.

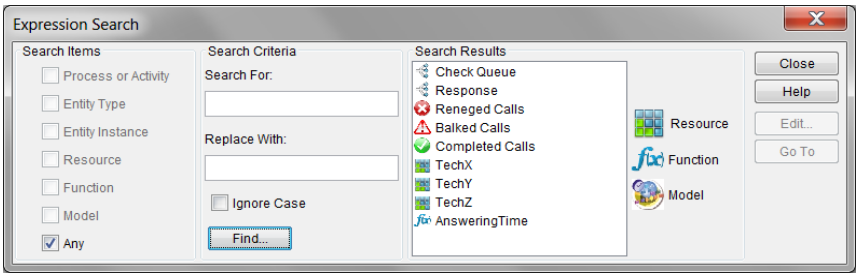
### *Expression Search...*

**Expression Search** is a quick way of searching for the existence of expressions or for expressions that contain specific text. Searching for text can also include replacing text. As with **Model Search**, the **Expression Search** dialog has three areas: **Search Items**, **Search Criteria**, and **Search Results**.




**Search Items** has seven check boxes: **Process or Activity**, **Entity Type**, **Entity Instance**, **Resource**, **Function**, **Model**, or **Any** (default). The other items become available for selection when **Any** is deselected. **Expression Search** searches the expressions of the selected **Search Items** based on the options set in **Search Criteria**. To find items that have expressions no matter what the text of the expressions, leave the **Search For** field empty. (Note that if the **Search For** field is empty, items that have Expressions stored in files will be located.) To search for specific text in expressions, enter the search text in the **Search For** field. All searches are "contains" searches. That is, there is a match if the text in the **Search For** field is contained within any line of an expression. Select **Ignore Case** to perform a case insensitive search. If the **Replace With** field is not empty, the text in the **Search For** field found in expressions will be replaced with the text in the **Replace With** field. There is no undo for replace actions. Also, replace actions are case sensitive only. Selecting **Ignore Case** will empty and disable the **Replace With** field. Expressions stored in files are not included in searches when the **Search For** field contains text.

Once the **Search Criteria** has been set, click the **Find...** button to perform the search. **Search Results** displays the items found. The type of each item found (Process or Activity, Entity Type, Resource, Function, or Model) is identified by an icon to the left of the name. Process, Activity, or Entity Type items display a scaled down version of their assigned icons. Resource, Function, and Model display an icon based on the legend to the right of the list. The example below shows a search on the `CallCenter.spm` demonstration model. The search was a case insensitive search for any expressions containing **type**. Four Activities, three Resources, and one Function were found.




Selecting an item will cause the **Edit...** button to activate. The properties of the item can be edited by

clicking the **Edit...** button or by double-clicking an item. The **Go To** button will activate if the item selected is a Process or Activity. Selecting **Go To** will take you to the level of the model where that item is located.

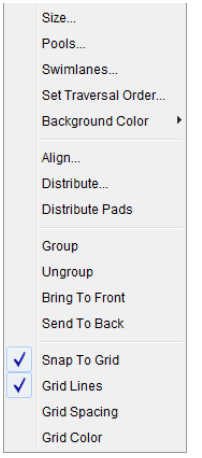
### *Metadata Search...*

**Metadata Search** is a quick way of searching for the existence of metadata or searching for specific metadata. See "Entering Metadata" for **Metadata Search** instructions.

### *Properties…*

Selecting **Edit/Properties…** will bring up the **Properties** dialog box for the selected item. This has the same effect as double-clicking on it. Use this menu item most often when you want to edit Hierarchical Processes, since double-clicking on them will show their internal structure and not bring up their dialog box.

## *Layout Menu*

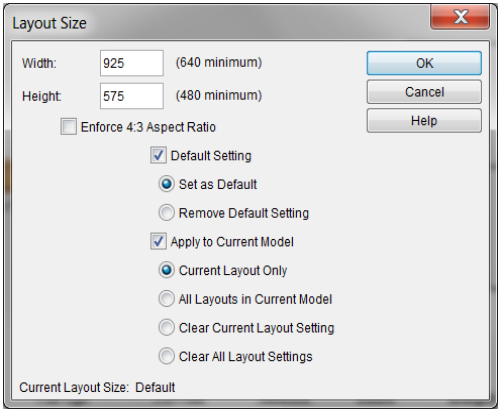



### *Size...*

**Size...** presents a dialog that allows you to specify the size (in pixels) used in the drawing of model layouts. The layout is the area on the screen where models are built and displayed. The default setting is a width of 925 and height of 575. The size can be changed for the current session, saved and used for subsequent SIMPROCESS sessions, saved with the current model layout and always used to display it, or saved and used with all layouts in a model. Each time a layout is displayed, its stored size will be used. The session setting will be used if there is not a stored size. The current size of the active layout

is displayed at the bottom of the dialog. **Default** is displayed if the active layout size is the current session's default layout size; otherwise, the actual dimensions are displayed.

**Enforce 4:3 Aspect Ratio** defaults to being not selected. If **Enforce 4:3 Aspect Ratio** is selected, the ratio of width to height must be 4 to 3. Selecting **Enforce 4:3 Aspect Ratio** will cause the default width of 925 and height of 575 to change to 928 and 626 respectively since 925 and 575 do not conform to the 4 to 3 ratio. This ratio is enforced whenever a change is made to the height or width. For example, if the height were changed to 712, the width would automatically change to 952, and the entered value of 712 would change to 714. Thus, both values are updated to the next higher values that meet the 4 to 3 ratio.




**Width** is the width of the layout in pixels (640 minimum).

**Height** is the height of the layout in pixels (480 minimum).

**Default Setting** either saves the entered width and height as the session default (**Set as Default**) and causes this size to be saved for use in future SIMPROCESS sessions, or it removes the saved session setting (**Remove Default Setting**) so that future SIMPROCESS sessions will use the 925 by 575 size. The setting used for the remainder of the current SIMPROCESS session (unless changed again via this dialog) will be the one specified here.

**Apply to Current Model** enables the following four options:

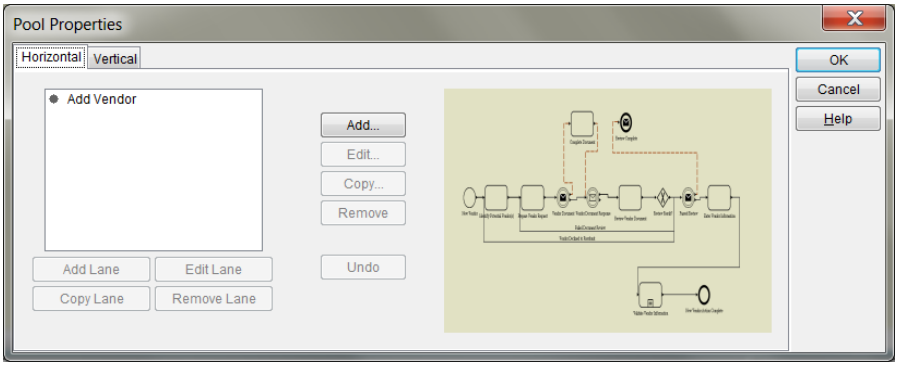
- **Current Layout Only** applies the entered values only to the active layout. The specified size of the current layout will be stored with the model when the model is saved.
- **All Layouts in Current Model** stores the entered values with all layouts in the active model so that they become permanent (if the model is saved).
- **Clear Current Layout Setting** removes a previously specified layout size for the current layout, so that the layout is subsequently redrawn (when necessary) using the current session layout size.

- **Clear All Layout Settings** removes stored layout sizes for all layouts of the current model. The layouts will subsequently display using the current session layout size.

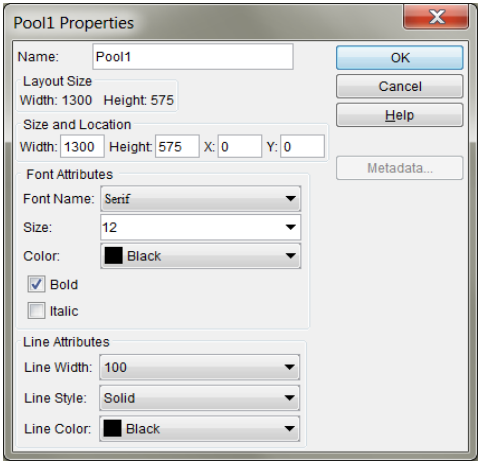
The current session setting is only changed if no checkboxes are selected or if the **Default Setting** checkbox is selected. Each time a layout is displayed, if a layout size is specified in the model, that size will be used; if none is found, the current session setting will be used instead.

### *Pools...*

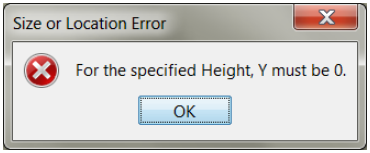
**Pools...** allows the addition of pools to the current layout. (Pools are for display purposes only and have no impact on the simulation.) The pools dialog has two tabs: **Horizontal** and **Vertical**. On the left side of each tab is a tree view of the pools. The right side has a miniature view of the current layout. Both horizontal and vertical pools can be on the same layout. The example below shows a modified version of the demonstration model, `Add Vendor.spm`.



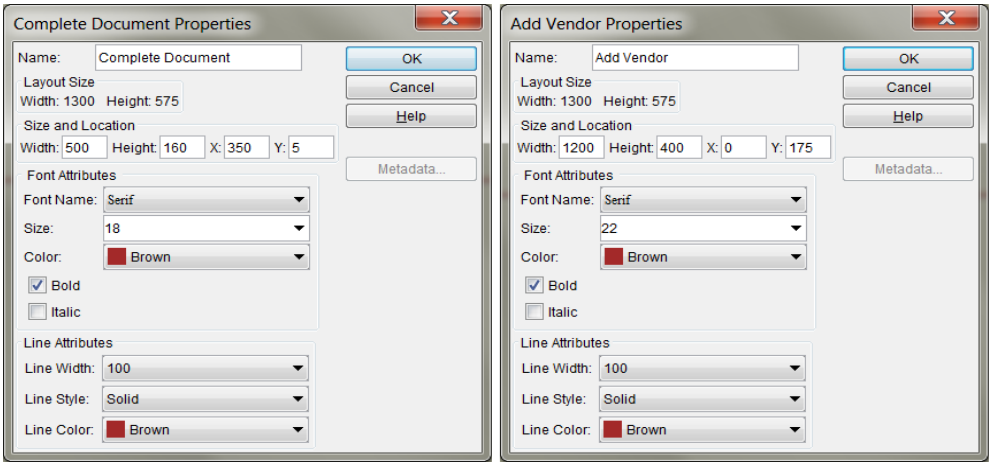

Click the **Add...** button to add a pool. This brings up a dialog which contains the **Name** of the pool, the **Layout Size**, the **Size and Location** of the pool, the **Font Attributes** for the name, and the **Line Attributes**.



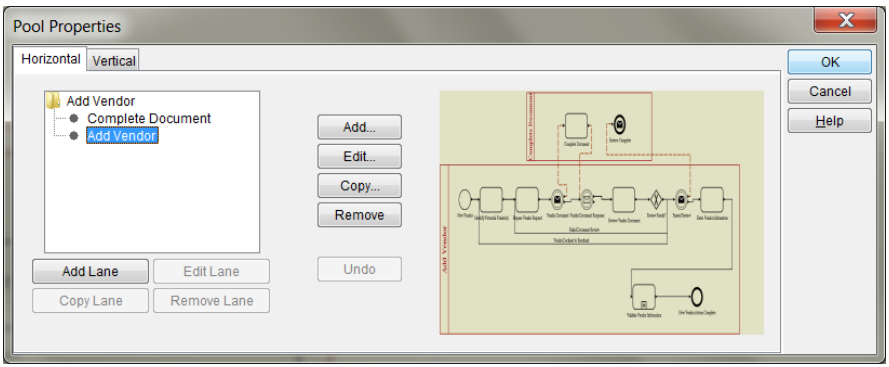

Edit the properties to set the appropriate name and display characteristics. The **Layout Size** is given for convenience since the size of a pool should not be larger than the size of the layout. In **Size and Location** specify the **Width** and **Height** of the pool. The **X** and **Y** values specify where the upper left corner of the pool will be located. So an **X** of 0 and a **Y** of 0 means the upper left corner of the pool will be located in the upper left corner of the model's frame. The **X** and **Y** values must take into account the **Width** and **Height** values. For example, if the **Width** in above example remains at 1300 and the **Height** remains at 575, then **X** and **Y** must both be 0 since any value larger than 0 would place the pool outside of the layout. If 10 is entered for **Y** the following error displays.



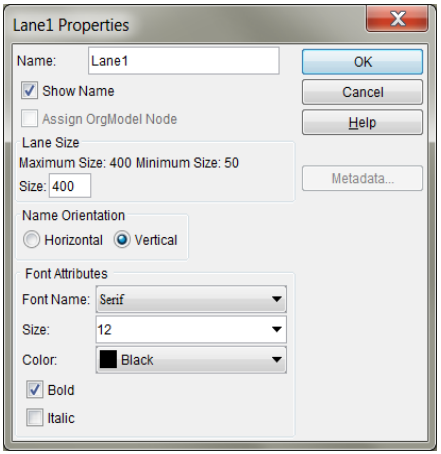

In the `Add Vendor.spm` demonstration model the following two pools are defined.




When a pool is selected the **Edit**, **Copy** and **Remove** buttons enable. If a pool is deleted using the **Remove** button, it can be restored with the **Undo** button. The **Add Lane** button also enables when a pool is selected.

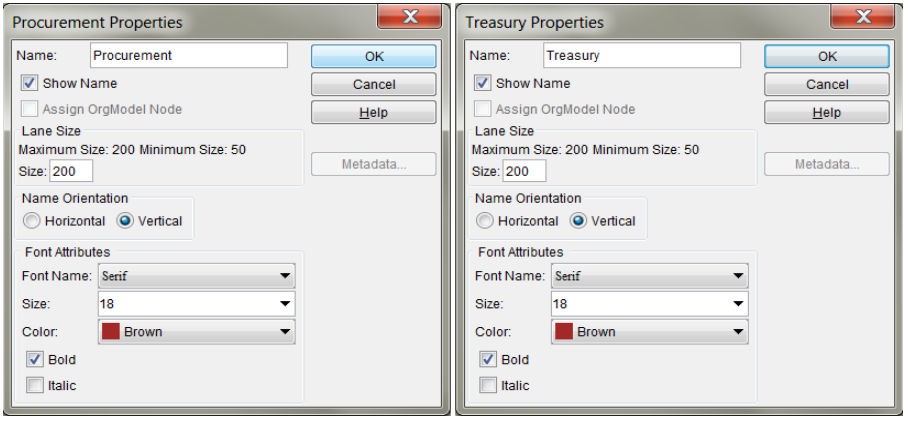



Multiple lanes can be added to a pool. When **Add Lane** is selected the lane properties display. These properties are similar to the swimlanes defined in the **Layout** menu option **Swimlanes...** (See "Swimlanes...," beginning on page 47 for a description of these properties including assigning **OrgModel Nodes**.) The difference is the **Lane** properties include **Lane Size**. Within **Lane Size** the **Maximum Size** is based on the **Height** of the pool for horizontal pools and is based on the **Width** of the pool for vertical pools. For example, the **Height** of the **Add Vendor** pool is 400 so the **Maximum Size** of the first lane defaults to 400.

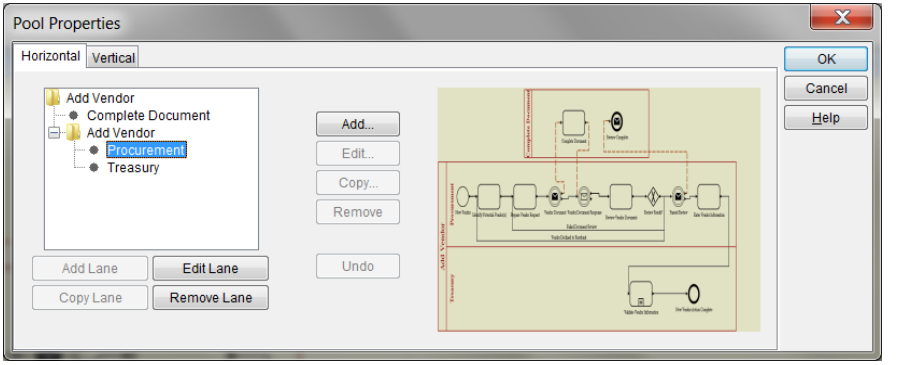



If a **Size** is entered that is greater than the **Maximum Size**, an error will appear when **OK** is selected.

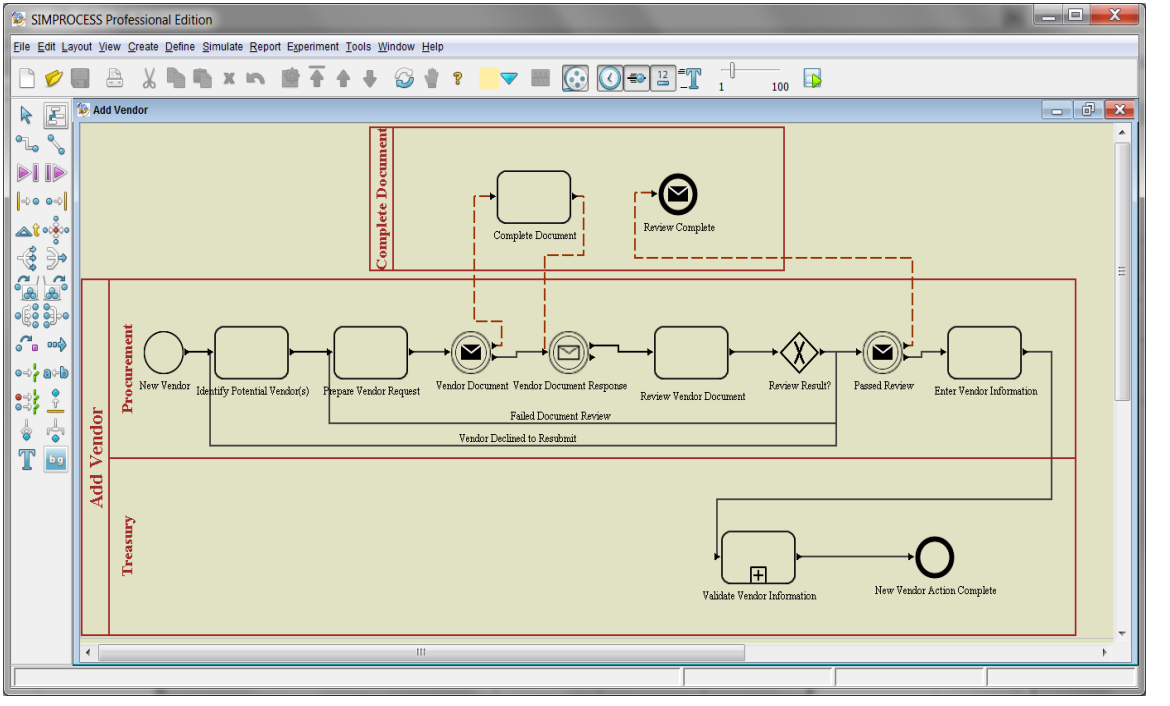
Note that if only one lane is added to a pool, the size of the lane will match the **Height** of the pool (or **Width** for vertical pools) no matter what value is entered for **Size**. The `Add Vendor.spm` demonstration model has two lanes defined for the **Add Vendor** pool.



When a lane is selected, the **Edit Lane** and **Remove Lane** buttons enable. The **Add Lane** and **Copy Lane** buttons will only enable if there is still space available for another lane (the new lane's **Size** can be at least 50). In the example below **Add Lane** and **Copy Lane** are not enabled since the **Size** of each lane is 200, which sums to 400, the **Height** of the **Add Vendor** pool.



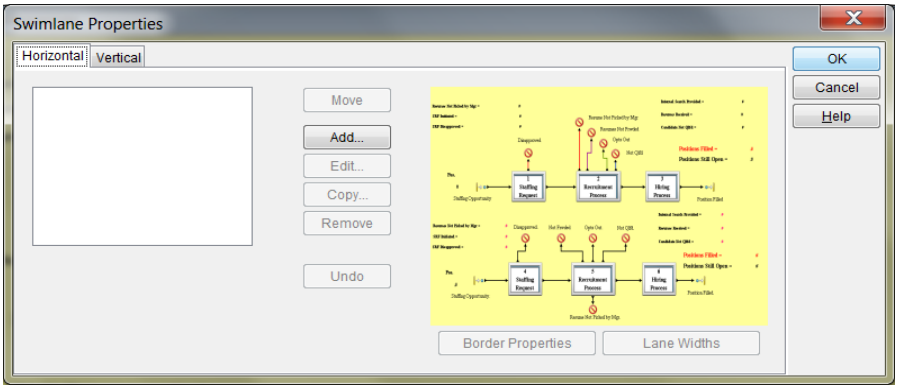

When **OK** is selected the pools display in the model.



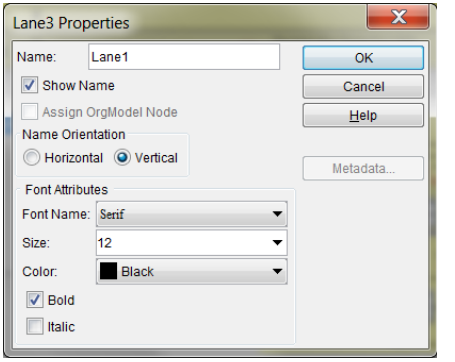
Also, the **Validate Vendor Information** subprocess in the `Add Vendor.spm` demonstration model has one pool with two lanes.

### *Swimlanes...*

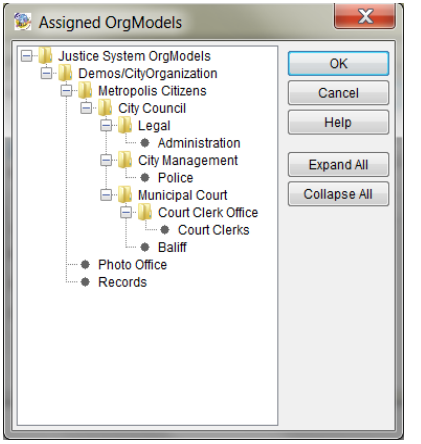
**Swimlanes...** allows you to add swimlanes to the current layout. The swimlanes dialog has two tabs: **Horizontal** and **Vertical**. On the left side of each tab is the list of swimlanes. The right side has a miniature view of the current layout. Both horizontal and vertical swimlanes can be on the same layout. The example below shows a modified version of the demonstration model, `Human Resources.spm`.



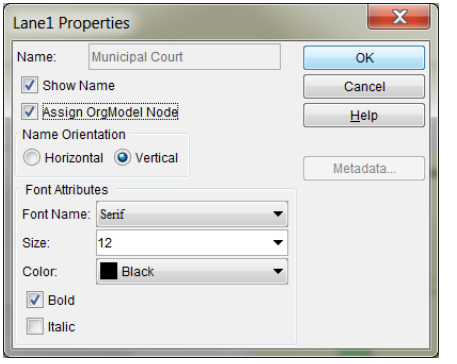

Click the **Add...** button to add a swimlane. This brings up a dialog which contains the name of the swimlane, whether the name should be displayed (**Show Name**), whether an OrgModel Node (Org Node) should be assigned to the swimlane (**Assign OrgModel Node**), whether the name should be displayed horizontally or vertically (**Name Orientation**, horizontal swimlanes only), and the **Font Attributes** for the name.



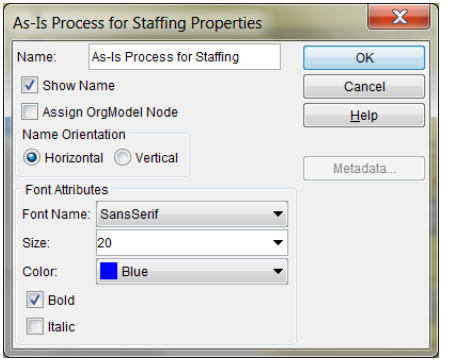
Edit the properties to set the appropriate name and display characteristics. **Assign OrgModel Node** is not enabled if there are no OrgModels assigned to the SIMPROCESS model. (See the *SIMPROCESS OrgModel Manual* for more information on creating OrgModels and assigning OrgModels to a SIMPROCESS model). When enabled and selected, **Assign OrgModel Node** displays a tree view of the OrgModels assigned to the SIMPROCESS model.



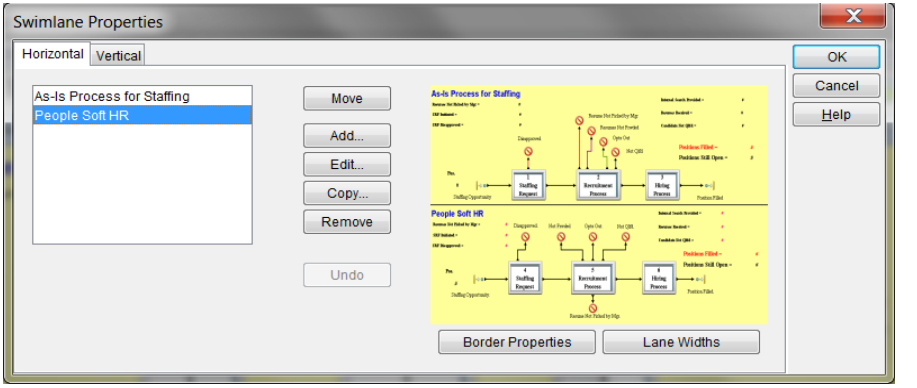

To assign an Org Node, select a node from the tree and click **OK**. Once an Org Node has been assigned to a swimlane, the **Name** field takes the name of the node and is disabled. Deselect **Assign OrgModel Node** to remove the Org Node assignment.



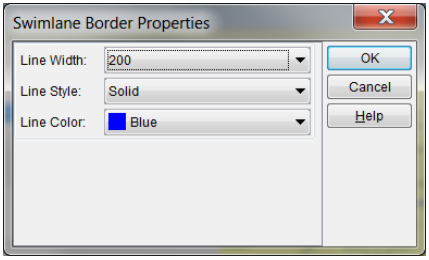

The **Metadata...** button opens a dialog for entering metadata. See "Entering Metadata" for a full discussion of entering SIMPROCESS metadata.



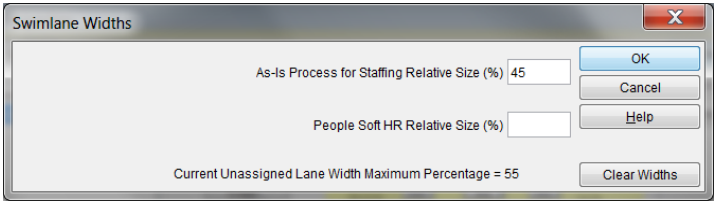

Adding a second swimlane causes a swimlane border to appear in the miniature view. Adding a third swimlane would cause a second swimlane border to appear. There is always one less border than swimlanes. The borders are evenly spaced down (or across for vertical swimlanes) on the layout.



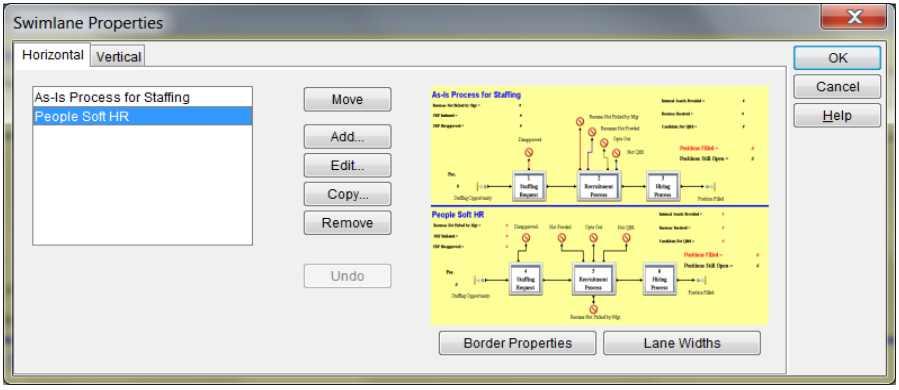

Once there are at least two swimlanes defined, the **Move** button and the two buttons below the miniature view activate. The **Move** button allows the rearrangement of the order of swimlanes without having to delete and recreate. The **Move** button causes the selected item to move down in the list. **Move** causes the item to go to the top of the list if the selected item is the last item. The **Border Properties** and **Lane Widths** buttons change the look of the borders and the widths of the swimlanes. **Border Properties** brings up a dialog that sets the **Line Width**, **Line Style**, and **Line Color** for each of the borders. The properties apply to the borders top to bottom for horizontal swimlanes and left to right for vertical swimlanes. Since there are only two lanes, there is only one border.



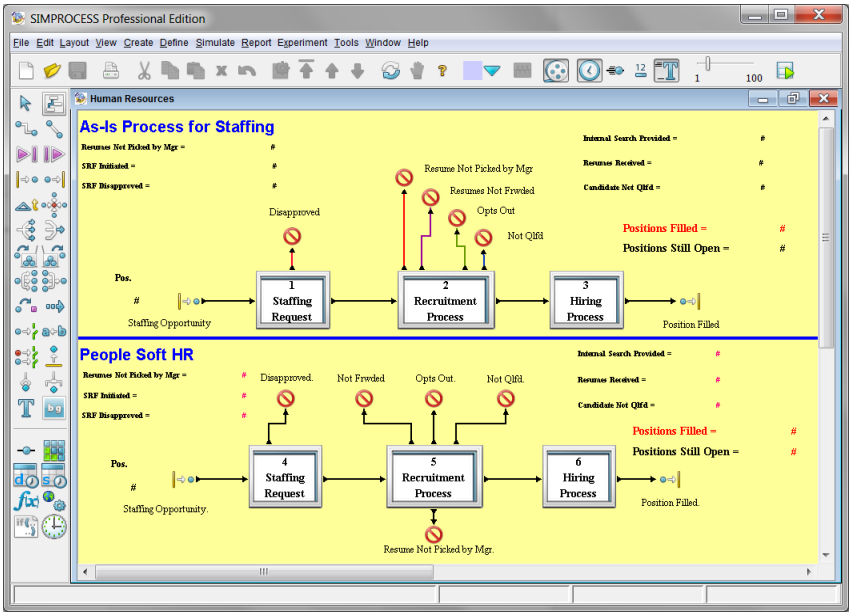

The **Lane Widths** button changes the widths of the swimlanes. The swimlane defaults to evenly spaced widths. Each swimlane will be 50% of the layout if there are two swimlanes. The dialog allows you to enter relative percentages for all or some swimlanes. Entries are not required for each swimlane. The minimum swimlane width is 5% of the layout. Swimlanes that do not have an entry will be evenly spaced across the remaining area of the layout. The **Current Unassigned Lane Width Maximum Percentage** shows the maximum value that can be assigned to a lane. **As-Is Process for Staffing** is assigned 50% of the layout area in the example below. This means 50% of the layout area is left for **People Soft HR**. The **Clear Widths** buttons removes all swimlane width assignments.




The image below shows the application of the border properties.



When **OK** is selected on the Swimlane Properties dialog, the swimlanes are drawn on the model layout. Note that swimlane borders or titles may not be edited by clicking on the layout. All edits must be done from the Swimlane Properties dialog.

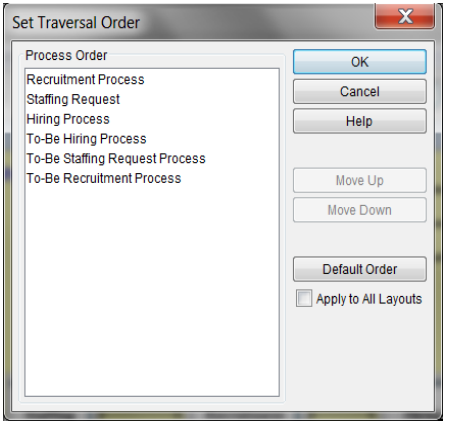



### *Set Traversal Order...*

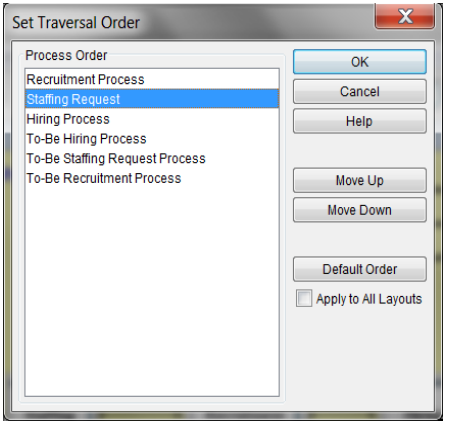
**Set Traversal Order...** is used to set the order in which Processes on the current layout will be traversed when printing or exporting a model. The traversal order can be set for any layout which has two or more Processes. Since printing or exporting a model requires traversing the whole model, the traversal order of each layout governs the order of the printing or exporting. The default traversal order for a layout is the order in which Processes were added to the layout. However, the default order of Processes on a layout may not be the logical order. In other words, it may make more sense for layouts to be printed or exported in a different order than the default order of each layout.

**Important**: The traversal order, whether default or user-defined, only impacts printing, exporting, and Process numbering. (See "View Menu" on page 56 for information on Process numbering.) It has no bearing on the simulation flow.

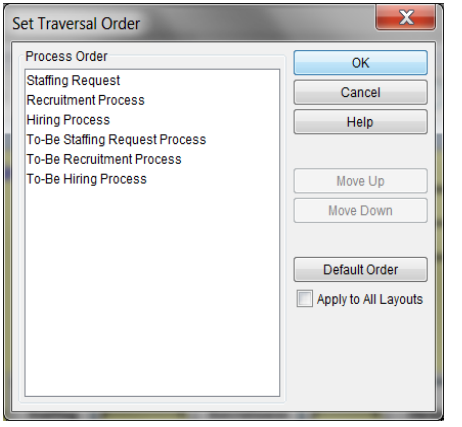
This menu item (which is also located on the contextual menu for a layout) displays a dialog that allows the order to be changed. For example, consider the Human Resources demo model displayed above. Below is the current order for that model.




For each set of as-is and to-be Processes, the layout shows **Staffing** first followed by **Recruitment**, then **Hiring**. However, when printed or exported, for the as-is Processes, **Recruitment** will print or export before **Staffing**, and, for the to-be Processes, **Hiring** will print or export first when it should be last. When a Process is selected, the **Move Up** and **Move Down** buttons enable. These buttons allow the Processes to be given a different traversal order.




When **OK** is selected, if the traversal order in the dialog is different from the default order, the order is stored as a part of that layout. Again, even though the traversal order is now different, this change in the traversal order has no impact on model simulation.



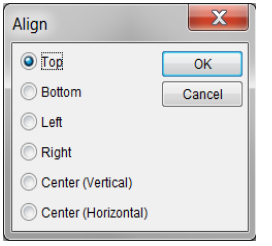

Selecting **Default Order** will remove any user-defined ordering for the layout and return the traversal order to the default order. If **Apply to All Layouts** is selected when **Default Order** is clicked, all user-defined ordering in the model is removed.

### *Background Color*

**Current Layout** changes the background color of the visible layout to the selected color.

**All Layouts** changes the background color of all layouts in the active model to the selected color.

### *Align…*




**Align...** aligns a number of selected objects according to various criteria.

**Top** aligns the tops of the selected objects.

**Bottom** aligns the bottoms of the selected objects.

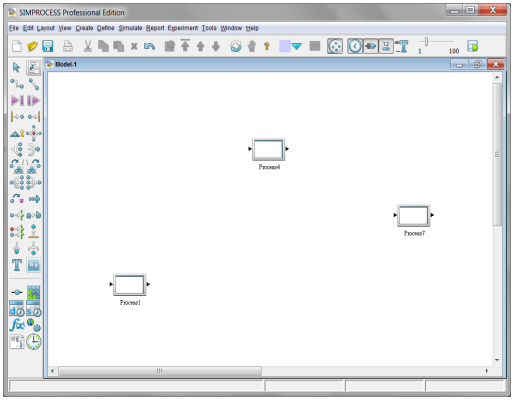
**Left** aligns the left sides of the selected objects

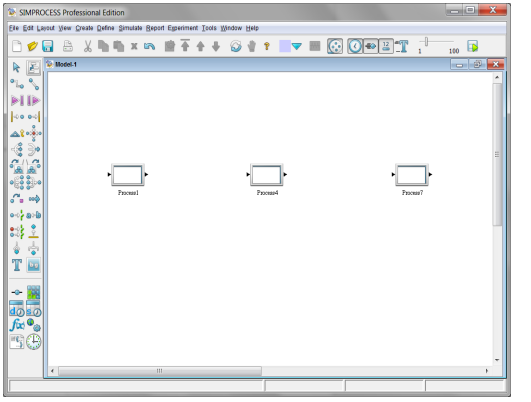
**Right** aligns the right sides of the selected objects

**Center (Vertical)** aligns the centers of the selected objects along a vertical line.

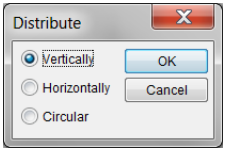
**Center (Horizontal)** aligns the centers of the selected objects along a horizontal line.

The screen shots below show the effect of using **Align** before and after aligning the horizontal centers:



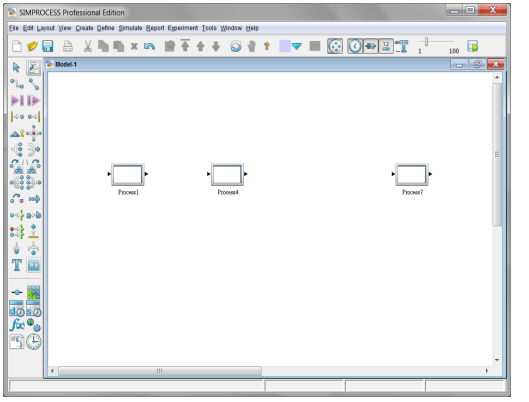

### *Distribute…*



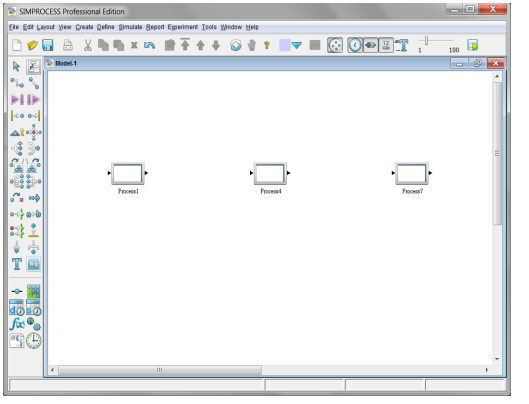

**Distribute...** distributes three or more selected objects so that they are equally spaced, vertically, horizontally, or circularly.

The screen shots below show the results of using **Distribute** on some unequally spaced objects.

Before using **Distribute**:




After using **Distribute**:




### *Distribute Pads*

Pads added to a Hierarchical Process can be spaced evenly by selecting **Distribute Pads.** Although intended for the Hierarchical Process, this menu item can be used for any Activity or Process.

**Group** combines multiple objects into a *group*. All normal editing operations that can be done on an individual object can be done on the group. This can be useful when the model is divided into logical sections. A section can be grouped and then moved with respect to the other sections. A group can be cut from the layout, or copied and pasted to create an identical group.

Use **Ungroup** to edit individual components of a group.

**Ungroup** breaks up a group into the original components that went into making the group.

**Bring To Front** brings an object to the front of the layout so it can be edited.

**Send To Back** sends an object that is at the front of the model layout to the back.

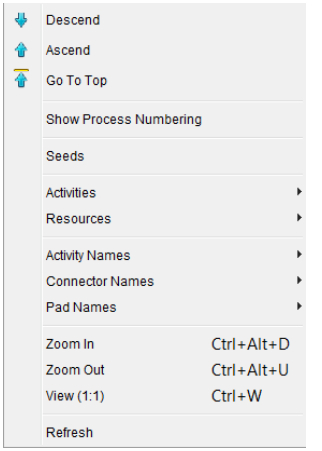
**Snap To Grid.** Once turned on, objects can only be placed on the layout at grid intersections.

**Grid Lines** places a grid on the model layout as a convenience in aligning objects. The grid has no significance to the model.

**Grid Spacing** changes the spacing of the grid. Three levels are offered: Fine, Medium, and Coarse.

**Grid Color** changes the color of the grid to the color selected on the color button.

## *View Menu*




**Descend** takes the model down one level in the model hierarchy.

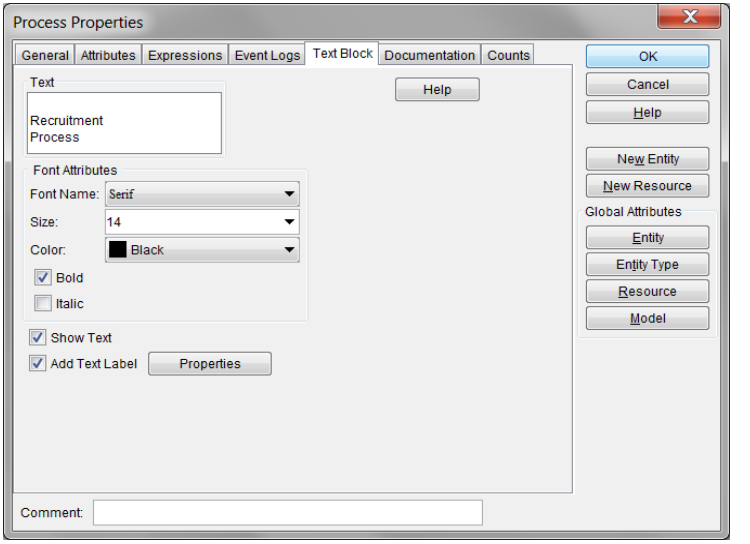
**Ascend** takes the model one level up in the Process hierarchy.

**Go To Top** takes the model to the top of the Process hierarchy.

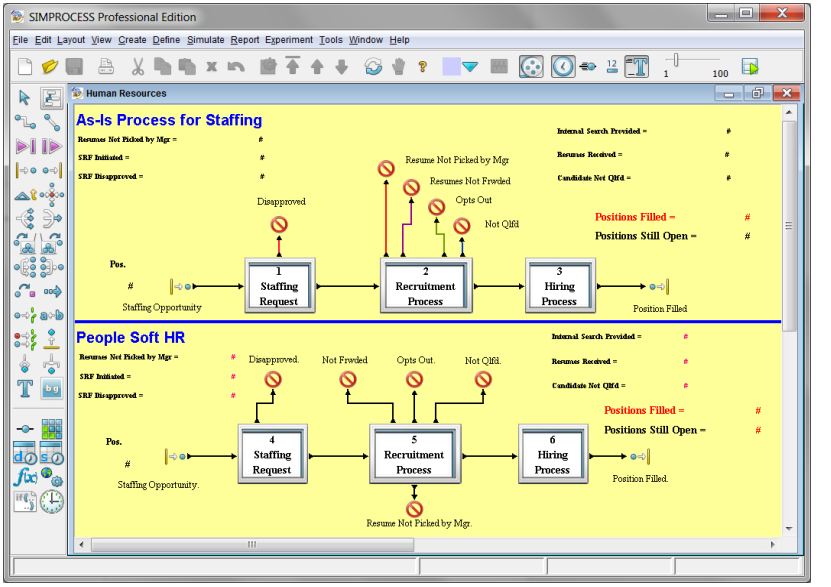
**Show Process Numbering** is a toggle that, when selected, displays an automatic hierarchical number for each Process in the model. Numbering is off by default for new models.

The number is purely for documentation purposes and has no impact on a simulation. Processes on the top layout are numbered 1, 2, 3, etc. Processes contained in the Process numbered 1 are numbered 1.1, 1.2, 1.3, etc. The numbering continues to the lowest level of the model and is based on the traversal order of the processes on each layout. The traversal order is the order that Processes were added to a layout (default order) or a user-defined order (see "Set Traversal Order..." on page 51).

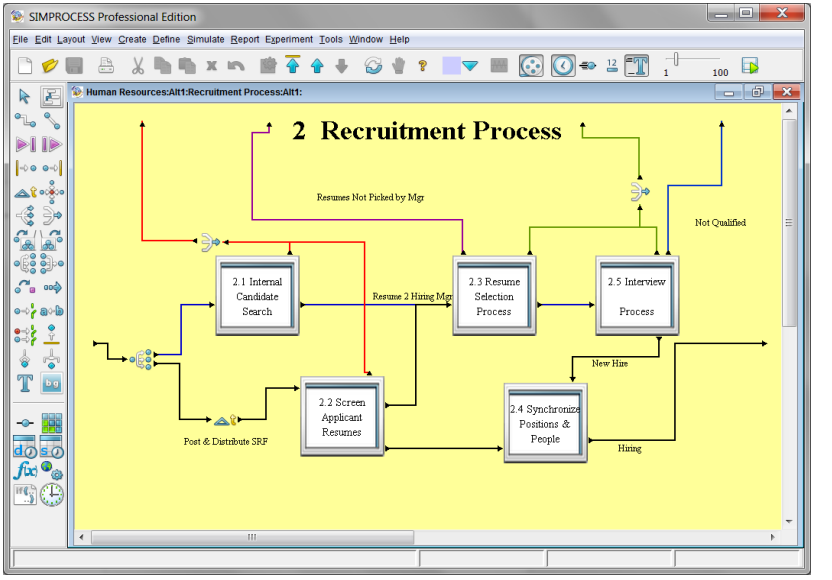
The number can display in two places, on the Process icon as a part of the Text Block and as a part of the Text Label that displays when the layout of the Process is viewed (see "Labeling with Text Blocks" on page 84). The number displays as a part of the Text Block if **Show Text** is selected on the **Text Block** tab of the Process properties, and the number displays as a part of the Text Label if **Add Text Label**, which is located below **Show Text**, is selected.




The number displays in line one and will precede any text entered in **Line 1 Text**. The **General** tab of the Process properties dialog contains the **Use Text Block** checkbox. When selected, the contents of the Text Block are used as the name of the Process. The Process number, even when displayed, is not a part of the Text Block properties so it will not be a part of the Process name. The example below shows the Human Resources demonstration model with Process numbering displayed. In this example **Line 1 Text** was empty for each Process so the number is the only item displayed in the line 1 location.




Descending into Process 2 (**Recruitment Process** in **As-Is Process for Staffing** swimlane) displays the number preceding the text in the first line of the Text Label. Note that the Processes within **Recruitment Process** are numbered with the number 2 as the first digit.



**Seeds** is used for viewing the random number stream seeds.

### *Activities*

**Hide** hides the selected Activity. The Activity and its Connectors to it will not be visible on the layout.

**Show All** makes all Activities and their Connectors visible.

**Show Attached** makes all the Activities that are connected to a selected Activity visible.

**By Resource...** allows you to view or edit resource Activity assignments.

**By Time Stamp...** allows you to view or edit Time Stamp key assignments at Activities.

**By Attribute...** allows you to view or edit Attribute usage at Activities.

### *Resources*

**By Activity** allows you to view or edit resource usage by Activity.

**Activity Names.** These menu items only affect the display of Activity names. The changes are not saved with the model.

**Show All** makes all Activity names visible throughout the model.

**Hide All** makes all Activity names invisible throughout the model.

**Local** shows or hides Activity names based on their individual properties (set with the **Properties** dialog **Show Name** checkbox). This is the default setting when a model is opened.

### *Connector Names*

These menu items only affect the display of connector names. The changes are not saved with the model.

**Show All** makes all connector names visible throughout the model.

**Hide All** makes all connector names invisible throughout the model.

**Local** shows or hides connector names based on their individual properties (set with the **Properties** dialog **Show Name** checkbox). This is the default setting when a model is opened.

### *Pad Names*

These menu items only affect the display of Pad names. The changes are not saved with the model.

**Show All** makes all Pad names visible throughout the model.

**Hide All** makes all Pad names invisible throughout the model.

**Local** shows or hides Pad names based on their individual properties (set with the properties dialog **Show Name** checkbox). This is the default setting when a model is opened.

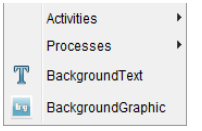
**Zoom In** magnifies a section of the layout to see more detail. Select **Zoom In** and click and drag the mouse to define the area on the layout to zoom.

**Zoom Out** is the reverse of **Zoom In**.

**View (1:1)** returns the layout window to its original size.

**Refresh** redraws the current screen.

## *Create Menu*




**Activities** provides an alternative way of creating Activities, rather than graphically dragging and dropping them from the Layout Toolbar.

Activities added to a Library can be added to this menu and/or added to the Library Toolbar.

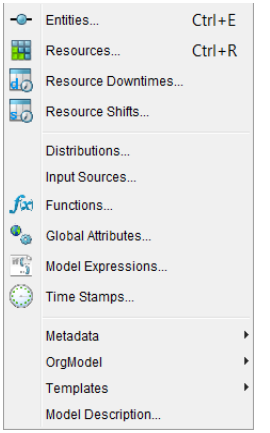
**Processes** provides an alternative way of creating Processes.

Processes added to a Library will be added to this menu.

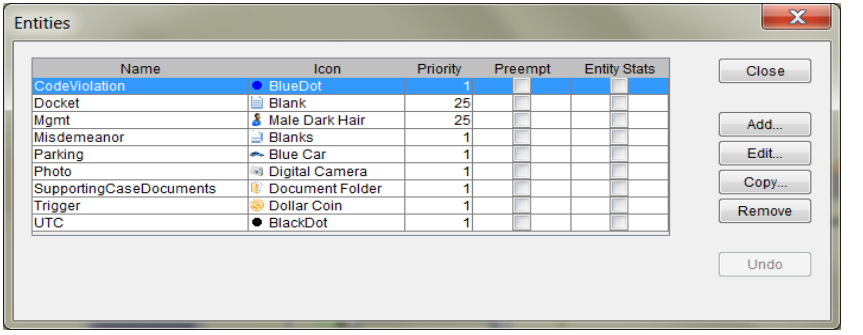
**BackgroundText** provides an alternative way of creating static or dynamic labels.

**BackgroundGraphic** provides an alternative way of changing the background.

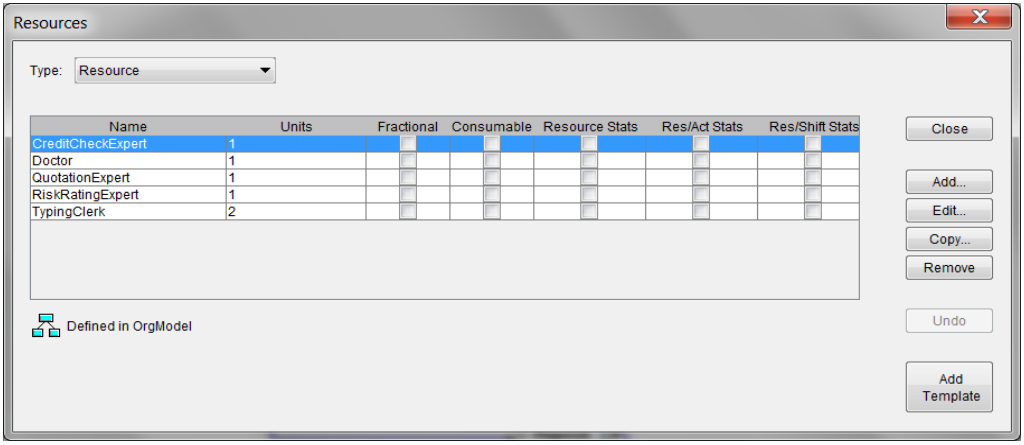
## *Define Menu*



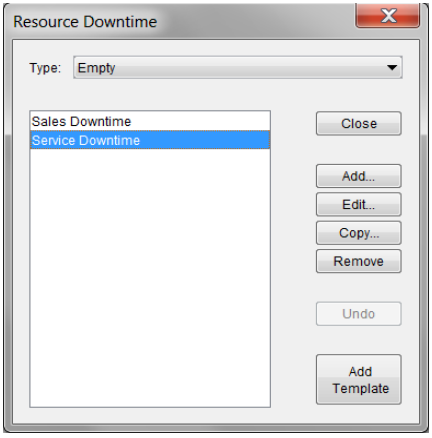

**Entities...** is used for managing Entity Types in the model.




**Resources...** is used for managing Resources in the model.




**Resource Downtimes…** is used for managing Resource Downtimes in the model.



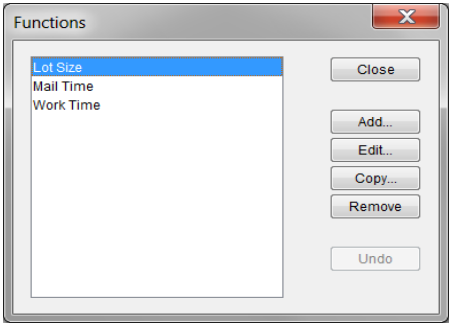

**Resource Shifts...** is used for managing Resource Shifts in the model (see "Resource Shifts").

**Distributions...** is used for managing customized **Standard**, **Tabular**, and **Auto Fits Distributions**. Once a Distribution is defined, it can be used throughout the model without the need to redefine the parameters of the distribution. (See "User Defined Distributions" on page 118.)

**Input Sources...** is used to create connections to an external **File**, **Spreadsheet**, or **Database**. Once an Input Source has been defined, it can be used throughout the model. (See "Input Sources" on page 131.)

**Functions…** is used for managing **Functions** (Expressions that return a value). Functions defined here

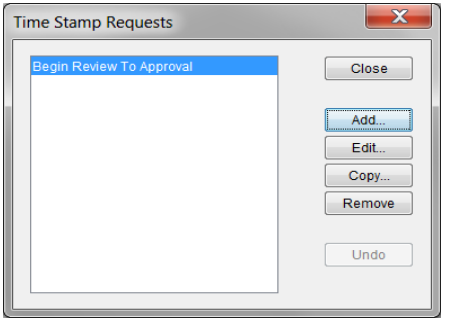
can be used throughout the model.




**Global Attributes...** is used for globally defining attributes for **Entity** instances, **Entity Types**, **Resources**, **Activities**, and the **Model**. See "Introduction to Attributes and Expressions" for more information on Attributes.

**Model Expressions...** defines customized Processing for the model at various points during a simulation. This topic is covered in detail in "Customizing a Model with Attributes and Expressions".

**Time Stamps…** manages **Time Stamps**. **Time Stamps** can be used as event logs (see "Event Logs").




**Metadata** contains three sub menu items: **Launch Metamodel Editor**, **Assign Metamodels**, and **Model Metadata...**. **Launch Metamodel Editor** opens the SIMPROCESS Metamodel Editor. **Assign Metamodels** assigns a SIMPROCESS Metamodel to the active SIMPROCESS model. **Model Metadata...** is used to enter metadata at the model level. See the *SIMPROCESS Metadata Manual* (SIMPROCESS Metadata) for information on these topics.

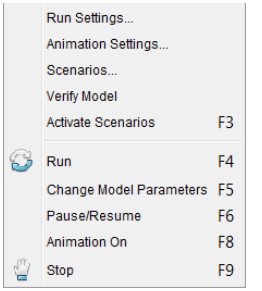
**OrgModel** contains two sub menu items: **Launch OrgModel Editor** and **Assign...**. **Launch OrgModel Editor** opens the SIMPROCESS Organization and Resource Model Editor. **Assign...** assigns a SIMPROCESS OrgModel to the active SIMPROCESS model. See the *SIMPROCESS OrgModel Manual*

(SIMPROCESS Organization and Resource Models) for information on these topics.

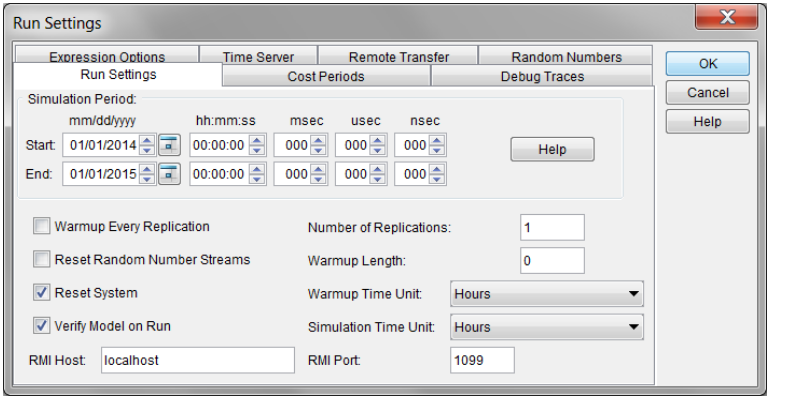
**Templates** defines and edits **Templates**. This option also allows saving templates to a Library or loading a new Library. See "Reusable Templates and Libraries".

**Model Description...** provides a place to document the model. See "document Subdirectory" for information on customizing the headings.

## *Simulate Menu*




### *Run Settings...*




**Run Settings** tab is used to set the run options for the simulation. (See "Run Settings" on page 137.)

**Cost Periods** tab defines cost periods for Activity based costing calculations. (See "Setting Up Cost Periods" on page 222.)

**Debug Traces** tab defines trace files of entity actions for debugging purposes. (See "Debug Traces" on page 139.)

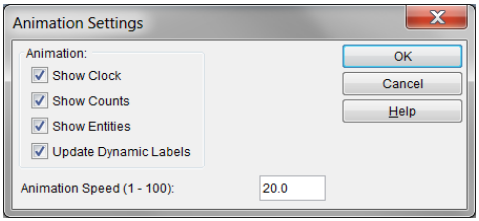
**Expression Options** tab offers options for the `OUTPUT` statement and the `BREAKPOINT` statement. (See "Expression Options" on page 140.)

**Time Server** tab allows the simulation time to be managed by the SIMPROCESS TimeServer. (See "Time Server" on page 142.)

**Remote Transfer** tab specifies the port to use for Remote Receive Transfer Activities. (See "Transfer Activity" on page 166.)

**Random Numbers** tab specifies the type of random numbers active for the simulation. (See "Random Number Generation" on page 116.)

### *Animation Settings...*




**Show Clock** turns the simulation time clock on or off while the simulation is running.

**Show Counts**. If **Show Counts** is turned on, each Activity or Process may display one or more numbers above its icon and, optionally, vertical bars representing the numbers. All Activities have the option to display Activity Count. Activity Count (and all other counts) can be turned off at each Activity or turned off for all Activities by using the Preferences (page 29). The number displayed is based on the Activity type.

- Generate Activities show the number of Entities generated.
- Dispose Activities show how many Entities have been disposed.
- All other Activities and Processes show how many entities are in that Process or Activity.

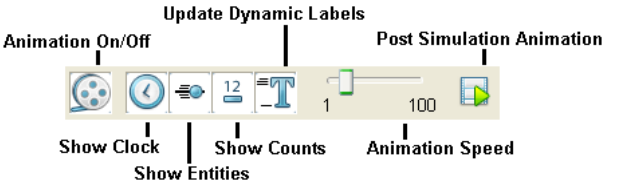
Some Activities can also display the number of Entities waiting for Resources (Wait Count), the number of Entities holding for a condition (Hold Count), and the number of Entities processing (Processing Count). See "Setting Activity Count Options," beginning on page 87 for more information.

**Show Entities** turns the display of Entities on or off during the animation. Showing Entities assists with visualizing the work flow.

**Update Dynamic Labels** turns the display of dynamic labels on or off during the animation.

**Animation Speed**. Changes the **Animation Speed** during the simulation. The fastest value is 100, and the default is 20. A smaller value is better while debugging the model.

The animation setting can also be changed by using the buttons and slider on the tool bar. A depressed button means the item represented by the button is turned on. Going from left to right, the buttons are **Animation On**, **Show Clock**, **Show Entities**, **Show Counts**, and **UpdateDynamicLabels**. The slider is for **Animation Speed**. The final button displays the post simulation animation controls. (See "Post Simulation Animation" on page 215.)




### *Scenarios...*

Used to define run Scenarios. See "Defining Scenarios" for more information.

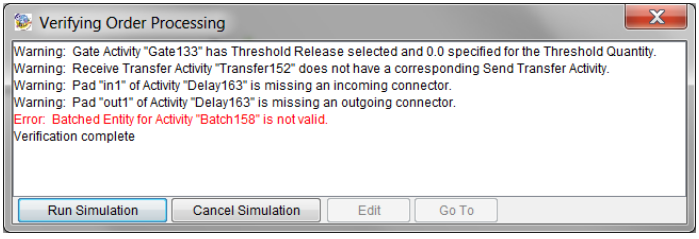
### *Verify Model*

**Verify Model** checks the model for potential problems. If there are issues, a list displays with Warnings and/or Errors. Warnings display in black and Errors display in red. An Error indicates a run time error is likely. Warnings simply indicate the model may not simulate correctly. Problems detected include

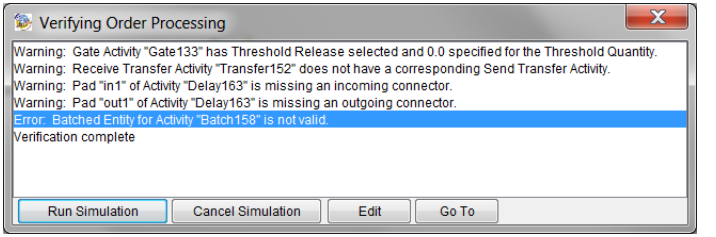
- All the Activities are not connected.
- Activities with a **Rank Method** of **Highest Attribute Value First** or **Lowest Attribute Value First** do not have a valid Attribute selected.
- Activities that can have a duration and have Resources assigned have a **Duration Value** of **None** along with Resources assigned to the Activity. (When **None** is selected for the **Duration Value** Resource requests are ignored.)
- Local Send Transfer Activities do not have associated local Receive Transfer Activities and vice versus.
- A local Send Transfer Activity connects with a local Receive Transfer Activity in an inactive Process alternative.
- A Branch Activity
  - has more than one **Otherwise** connector
  - has more than two outgoing connectors when branching on a Boolean attribute

  - has more outgoing connectors than Entities defined when branching on Entity Type
  - has two outgoing connectors branching on the same Entity Type
  - has one or more outgoing connectors with no **Value** set when branching on **Smallest Value** or **Largest Value**
  - has branch probabilities that do not sum to 1.0 when branching on **Probability**
- A Gate Activity
  - has **Release Threshold** selected with **Release Quantity** of 0
  - has an invalid **Batched Entity** (only checked if **Batch Entities** is selected)
- A Join Activity has an undefined **Family Name**
- An Assemble Activity
  - has no **Component Entities**
  - has an invalid **Assembled Entity**
- A Synchronize Activity has no Input and Output Pads
- A Batch Activity has an invalid **Batched Entity**
- A Transform Activity has an invalid **Output Entity**
- A Generate Activity
  - has an invalid **Default Entity**
  - does not have one and only one exiting Connector with **Generated Entity** specified
- A Split Connector has an invalid **Output Entity**

If **Verify Model on Run** is selected in the **Run Settings,** verification is done automatically when a simulation starts. A notification of any problems found will be displayed along with an option to stop the simulation (**Cancel Simulation**).


Verifying Order Processing
Warning: Gate Activity "Gate133" has Threshold Release selected and 0.0 specified for the Threshold Quantity.
Warning: Receive Transfer Activity "Transfer152" does not have a corresponding Send Transfer Activity.
Warning: Pad "in1" of Activity "Delay163" is missing an incoming connector.
Warning: Pad "out1" of Activity "Delay163" is missing an outgoing connector.
Error: Batched Entity for Activity "Batch158" is not valid.
Verification complete
Run Simulation
Cancel Simulation
Edit
Go To

Selecting an item in the list activates the **Go To** button and, if the item can be edited directly, the **Edit** button also activates. The **Go To** button closes the verification dialog and goes to the layout of the model that contains the problem item and highlights the problem item. If **Edit** is selected, the properties for the problem item are displayed without closing the verification dialog. If the problem was corrected the item is removed from the list when the properties dialog is closed.


Verifying Order Processing
Warning: Gate Activity "Gate133" has Threshold Release selected and 0.0 specified for the Threshold Quantity.
Warning: Receive Transfer Activity "Transfer152" does not have a corresponding Send Transfer Activity.
Warning: Pad "in1" of Activity "Delay163" is missing an incoming connector.
Warning: Pad "out1" of Activity "Delay163" is missing an outgoing connector.
Error: Batched Entity for Activity "Batch158" is not valid.
Verification complete
Run Simulation
Cancel Simulation
Edit
Go To

### *Activate Scenarios*

When selected, a Scenario can be selected before the simulation starts. See "Running Scenarios" for more information

### *Run*

**Run** verifies the model (if selected) and then starts the simulation running.

### *Change Model Parameters*

This item, available only while running a model which has attributes identified as Model Parameters, will pause the simulation and allow parameter values to be changed. See "Running a Simulation with Model Parameters," beginning on page 110 for more information on Model Parameters.

### *Pause/Resume*

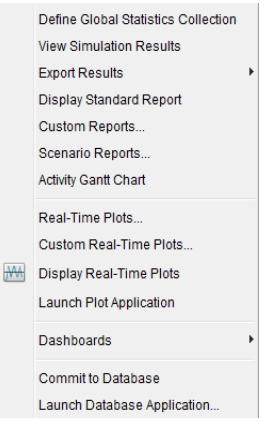
If the simulation is running, it pauses the simulation. If the simulation is paused, it resumes running the simulation.

**Stop** stops the simulation and ends the collection of statistics.

### *Animation On*

**Animation On** turns animation on or off, but does not turn on animation that is turned off in the **Animation Settings**.

## Report Menu




**Define Global Statistics Collection** sets which statistics are collected during the model execution. See "Default Performance Measures" on page 243.

**View Simulation Results** displays selected statistics in a table format with options for saving the statistics to a file and view the statistics graphically. See "View Simulation Results" on page 229.

**Export Results** contains three items: **Database...**, **Spreadsheet...**, and **Simulation...**

- **Database...** is used to create SQL statements to export simulation information and results to databases. Insert, Update, and Delete SQL statements can be created. See "Defining and Executing Database Exports" in Part B of the *SIMPROCESS User's Manual* for more information.
- **Spreadsheet...** is used to create output spreadsheets. See "Defining and Executing Spreadsheet Exports" in Part B of the *SIMPROCESS User's Manual* for more information.
- **Simulation...** exports the results of the current model to a tab-delimited file. The data from all reports selected for the current model will be written to this file. The file can be opened with a text editor or spreadsheet.

**Display Standard Report** allows viewing reports containing the statistical results of a simulation run. See "Standard Report" on page 243.

**Custom Reports...** manages the model's Custom Reports See "Custom Reports".

**Scenario Reports...** manages the model's Scenario comparison reports. See "Comparing Scenarios".

**Activity Gantt Chart** allows the creation of Gantt charts based on the results of the simulation. See "Activity Gantt Chart" on page 206.

**Real-Time Plots...** sets which real-time plots to display during or after the simulation run. See "Defining Plots" on page 259.

**Custom Real-Time Plots** creates plots with multiple values to view during or after the simulation run. See "Custom Plots" on page 270.

**Display Real-Time Plots** selects real-time plots for viewing. See "Displaying Real-Time Plots" on page 263.

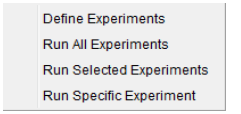
**Launch Plot Application** opens a blank plot window. Saved plots may then be opened for viewing. See "Displaying Plots Remotely" on page 263.

**Dashboards Defines** new dashboards for use with models, or **Assigns** previously defined dashboards to a model. See "SIMPROCESS Dashboards".

**Commit to Database** saves simulation results in the SIMPROCESS database (SimProcDB). Commit to Database is described in detail in "SIMPROCESS Database".

**Launch Database Application** starts the database application from within SIMPROCESS. The Manage Results form launches automatically when launching MS Access from this menu item. The Manage Results form is described in detail in "SIMPROCESS Database".

## *Experiment Menu*




**Define Experiments** sets up the experiments to run. The experiments are stored in the file `Experiments.xml`. Defining Experiments is described in detail in "Experiment Manager".

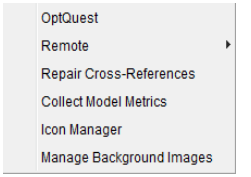
**Run All Experiments** attempts to run every experiment defined.

**Run Selected Experiments** attempts to run experiments for which the **Selected** field is checked.

**Run Specific Experiment** enters an experiment name that SIMPROCESS will attempt to run.

Running experiments is described in detail in "Experiment Manager".

## Tools Menu




**OptQuest** executes OptQuest optimization from OptTek. See "OptQuest for SIMPROCESS" for more information.

**Remote** has six sub menus.

- **Start Local Dashboard Server** starts the Dashboard Server to run Dashboards locally. See "Displaying Dashboards"
- **Start Local Time Server** starts the Time Server locally. See "Time Server" on page 142.
- **Start RMI Registry** starts the Java RMI Registry. **Start SPServer** will not activate until the Java RMI Registry has been started.
- **Stop RMI Registry** stops the Java RMI Registry.
- **Start SPServer** starts SPServer. SPServer must be started for External schedules to operate. See "Adding an External Schedule"
- **Stop SPServer** stops SPServer.

**Repair Cross-References**. Cross references are used in SIMPROCESS models to track Entities, Resources, and Attributes so items cannot be deleted that are in use. Models developed in releases 3.0 through 3.1.1 could have invalid cross references. Recommend running this utility on models developed in release 3.0 through release 3.1.1. The action is applied to the active model.

**Collect Model Metrics** displays a list of metrics for the active model. The metrics can be saved to a file. Metrics include

Model Name

Number of each type of Activity (Delay, Generate, etc.)

Number of Process Alternatives

Number of Entities, Resources, and Plots

Number of each type of Expression

Number of each type of Attribute

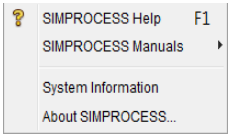
**Icon Manager** is used to import, export, and manage image files. A single image file can be imported for use as an icon, or multiple files (such as a directory of image files) can be imported. See "Importing Graphics Image Files" on page 202.

Manage Background Images is used to import, export, and manage background image files. See "Background Images" on page 202.

## Window Menu

This displays a list of open models. It is used to change the active model.

## Help Menu




**SIMPROCESS Help** displays a list of main help topics. **NOTE**: On Windows systems SIMPROCESS Help uses Internet Explorer. To eliminate the need to give permission to run active content, open Internet Explorer and go to **Tools** and select **Internet Options**. Select the **Advanced** tab and scroll down to the **Security** category. Check the option "Allow active content to run in files on MyComputer*".

**SIMPROCESS Manuals** opens the *SIMPROCESS Getting Started Manual*, each part (Part A, Part B, Part C, and Appendices) of the *SIMPROCESS User's Manual*, the *SIMPROCESS Metadata Manual*, and the *SIMPROCESS OrgModel Manual*. These PDF files are the complete documentation set for SIMPROCESS. They will open using the application designated for PDF files by the platform on which SIMPROCESS is installed. On Linux systems, there must be a `view.properties` file as described for the **View** button on the **Documentation** tab of Activity and Process properties dialogs. (See "Common Activity Input Fields" on page 81.)

**System Information** displays a dialog that lists the relevant system information. It also includes a **Run GC** button. This button calls Java garbage collection and updates the Java memory information.

**About SIMPROCESS** displays information about SIMPROCESS, including the version, the copyright, and technical support information.

CHAPTER 2

# *SIMPROCESS Basics*

A SIMPROCESS model contains the following components:

- Processes
- Activities
- Entities
- Resources
- Connectors
- Pads

***Processes*** and ***Activities*** represent business operations in a SIMPROCESS model. SIMPROCESS models can be arranged in a hierarchy, with Processes encompassing other Processes and Activities.

# SIMPROCESS Components

## Processes

A set of ***Processes*** can represent the operation of a business at a very high level. This level represents only an outline of the business Process.

Activities represent the details of business operations. For example, in a mail order fulfillment operation, when a customer order is received, processing steps might include:

1. Identifying the customer.
2. Creating or accessing a customer profile.
3. Verifying the customer profile against information contained in the customer's order.

Each of these steps can be modeled as an Activity. Collectively, they comprise a single Process that might be called "Access/Create Customer Profile."

The Process construct allows a business Process to be broken down into successively more detailed layers.

A Process can be (and usually is) composed of other Processes and Activities. Activities cannot be decomposed.

## Activities

SIMPROCESS contains a suite of ***Activities***, each reflecting a different type of action. Actions can be physical or logical.

## Entities

***Entities*** are objects that circulate through the model. They represent things (e.g., parts, deliveries, people) or information (orders, service requests, etc.) that flow from Activity to Activity. The customer order is an Entity in the order fulfillment process.

Unlike Processes and Activities, which appear as icons in the model layout, Entities aren't visible until a simulation is run. During the simulation, if animation is turned on, they emerge as icons flowing through the model.

## Resources

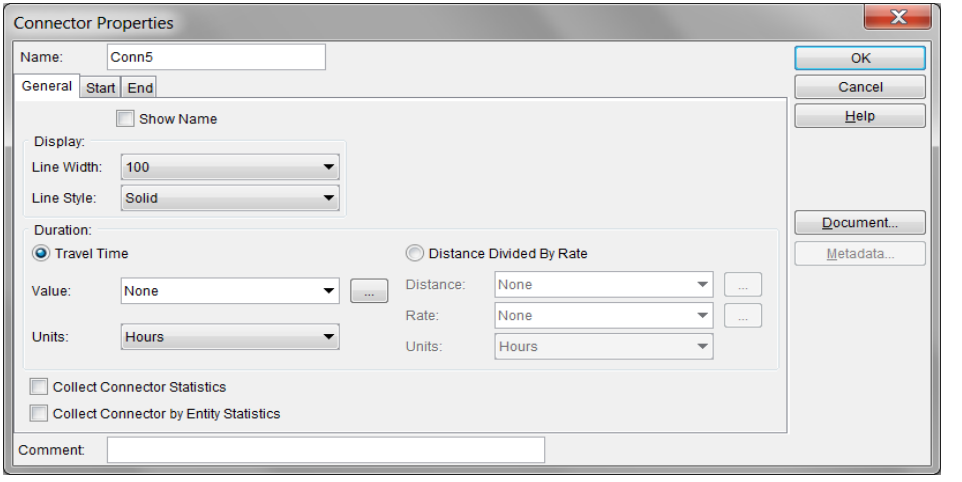
***Resources*** are the agents that add value to Entities or perform work at Activities. Examples include:

- A customer calls in an order, which requires a clerk to handle it. Order entry is the Activity, the order is an Entity, and the clerk is a Resource.
- A truck is required to deliver merchandise to the customer; the truck is a Resource.

The way to minimize cycle time and Activity costs is by experimenting with different levels of Resources and different costs. The availability of a Resource affects the amount of time it takes an Entity to flow through the Process. Lack of Resources can be a cause of bottlenecks in a business Process. A customer order might arrive while two clerks are busy handling other tasks. Order fulfillment is delayed until a clerk becomes available. The amount of time the customer order spends waiting for an available clerk is shown in the Entity Cycle Time by State output report as Wait for Resource. Another way to describe this situation is that the order waited in a queue for the available Resource. Knowing how Resources are used is a key factor in understanding and improving upon the way a business operates.

## Connectors

***Connectors*** link Activities and Processes together and are the paths used by Entities to flow through the model. Connectors can have delay times.



### Connector Names

A default Connector name (such as Conn44) is assigned. To change the Connector Name, edit the **Name** field in the Connector properties.

### Displaying Connector Names

The **Edit Preferences** option, on the **Edit** menu, determines if names of new Connectors are displayed in the model. However, individual **Connector** dialogs have **Show Name** check boxes that will override the model default.

The **Name** field is displayed across the middle of the Connector if **Show Name** is selected.

### Display Properties

The **Line Width** and **Line Style** properties control the appearance of the Connector. Defaults for **Line Width** and **Line Style** can be set in the **Preferences**. See "Preferences" on page 29.

### Duration

A Connector defaults to no **Duration**. **Duration** can be specified by setting a **Travel Time** or **Distance Divided By Rate**. If using **Distance Divided By Rate**, a value must be set for **Distance** and **Rate**, and **Rate** must not be zero. No units are assumed for **Distance** or **Rate**. The **Units** field applies to the value that results from **Distance** being divided by **Rate**.

Note that a Connector **Duration** affects Entity animation. When no Connectors on a layout have a **Duration**, one Entity moves at a time. This is because the Entity movement occurs in zero simulation time. However, when Connectors on a layout have a **Duration**, multiple Entities can be moving at the same time since the movement represents the passing of time. If some Connectors on a layout have a **Duration** and some do not, the movement of Entities on Connectors with a **Duration** will stop while Entities cross Connectors with no **Duration**. The **Units** set for **Travel Time** or **Distance Divided By Rate** also affect the animation of Entity movement. It is recommended (for animation purposes only) that the **Units** of the Connector **Duration** match the **Simulation Time Unit** on the **Run Settings** dialog. (See "Setting the Simulation Time Unit" on page 108.) If the **Simulation Time Unit** is different from the **Units** of a Connector **Duration**, then it is possible that either the Entities will move very slowly across the Connector no matter what Animation Speed (page 65) is set or the Entities will never show up (again, no matter what Animation Speed is set). If animation is not a consideration, then any value for **Units** is valid.

### Connector Statistics

**Collect Connector Statistics** and **Collect Connector by Entity Statistics** are used to request statistics for the specified Connector. See "Connector Statistics," beginning on page 256 for more information.

### *Connector Start/End*

The **Start** and **End** tabs allow the Connector to be moved without deleting and recreating the Connector. The **Start** tab displays the available starting Pads for the Connector, and the **End** tab displays the available ending Pads for the Connector. If **Start** and/or **End** has a selection, the changes are applied when **OK** is selected. To clear a selection, press the Control key while clicking on the selected item.

## *Pads*

***Pads*** are small triangular objects attached to Activities and Processes which serve as attachment points for Connectors. A single Pad can connect one or (possibly) more Connectors. Entities flow in one direction, entering nodes at input Pads and exiting at output Pads. Three sizes of Pads are available: small, medium, and large. The Pad size can be changed on the Pad properties dialog, or by right clicking on the Pad and choosing **Pad Size**. The size of all the Pads on an Activity or selected Activities can be changed by right clicking on a selected Activity and choosing **Pad Size**.

Pads also connect one level of a Process hierarchy to another. Pads can be queueing areas for Entities waiting for a Resource or condition.

## *Putting it Together*

A SIMPROCESS model shows a business Process as a set of Nodes (Processes and Activities) connected by Connectors. Entities are generated from one or more Generate Activities, traverse the model, and finally proceed to a Dispose Activity, where they are disposed. Entities pass through other Activities such as Delays and Branches.

A model is built by supplying numeric and symbolic attributes to the various Activities and the Entities that are processed at these Activities. The Resources needed to process the Entities are also defined.

The end result is a dynamic model of the business Process. Bottlenecks can be seen as they occur when simulations are run on this model. Reports and statistics may be generated describing the flow of people, materials, and information and quantifying how Resources are used. The model may continue to be modified in order to experiment with different scenarios.

A simple model can be built with just three Activity objects: Generate, Delay, and Dispose.

All models require a Generate Activity to generate Entities and a Dispose Activity to end the processing of Entities. Delay Activities are used to represent actions.

There are some things that are common to most Activities, such as the Activity name and Resources required by the Activity. This chapter begins with a discussion of the input fields and command buttons used to define these items. The remainder of the chapter describes the core SIMPROCESS Activities in detail, with particular attention devoted to the Generate Activity and the Entities.

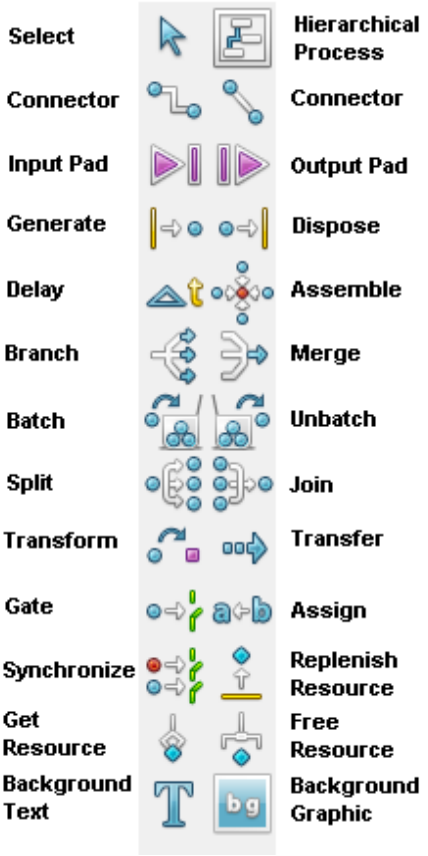
The remaining SIMPROCESS Activities are described in Chapter 4–Activity Modeling Constructs, beginning on page 146, and in “Explicitly Getting and Freeing Resources” on page 189.

# Model Toolbar

The Model Toolbar is the two columns of buttons running down the left margin of the SIMPROCESS window.

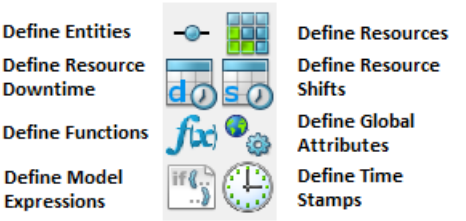
## *Layout Buttons*

The buttons in the top section of the toolbar are used to place model building blocks on the SIMPROCESS layout — the central region of the SIMPROCESS window.



## *Define Menu Buttons*

These buttons perform the same actions as the corresponding **Define** menu items. (See "Define Menu" on page 61.)



# Adding and Editing Activities

## *Adding Objects to the Layout*

Begin by adding a Generate Activity to the model. Click once on the Generate Activity button.

Next, point and click on the SIMPROCESS layout. A Generate Activity icon is added at that location.

Press and hold the **Shift** key while clicking on the layout to add several activities of the same type, i.e., Generate. Each time the layout is clicked, a Generate icon is added to the layout. Release the **Shift** key before dropping the last icon or click once on the Select tool to deactivate the Generate button.

## *Removing Objects from the Layout*

Select an object such as an Activity icon from the layout and press the **Delete** key. Several items may be removed at one time by drawing a rectangle around the objects and pressing **Delete** or selecting **Edit/Clear** from the menu or the popup menu.

## *Common Activity Input Fields*

Activity Properties dialogs have the following common input fields:

- **Name** is the name chosen to identify the Activity. This name appears below the Activity, and it can be moved on the layout.
- **Icon** identifies the graphic icon representing the Activity.
- **Comment** is a one-line comment about the Activity. This comment appears in the status bar when the Activity is selected. The comment can contain hypertext that use the protocols http, https, or file (only file:/// is recognized). To include hypertext the full URL must be included (such as http://www.simprocess.com). The protocol portion (http://, https://, or file:///) is removed and the remainder of the URL becomes the hypertext. For example if “See http://www.simprocess.com for more information” is entered, “See www.simprocess.com for more information” is displayed. If specific hypertext is desired include it immediately following the URL enclosed by parentheses and quotes. Entering “See http://www.simprocess.com(“SIMPROCESS”) for more information” will display as “See SIMPROCESS for more information”.

**NOTE**: All **Comment** fields in SIMPROCESS can contain hypertext. If the properties of Activities, Entities, Resources, Attributes, or Time Stamps are included in Custom Reports (see "Custom Reports"), and the **Comment** contains more than one URL, only the first URL will be active when the Custom Report is saved to a document format (`pdf`, `docx`, etc.).

- **Documentation** tab contains a **Document...** button that opens an edit window for adding descriptive text about the Activity. (See "document Subdirectory" for information on customizing headings.) Next to the **Document...** button is the **Metadata...** button. The **Metadata...** button opens a dialog for entering metadata. (See "Entering Metadata" for a full discussion of entering SIMPROCESS metadata.) This tab also contains a field for adding a link to a URL or another document. (See "Export" on page 19.) The **View** button launches the preferred web browser if **Is URL** is selected. If **Is URL** is not selected, SIMPROCESS assumes the URL is a file and will attempt to open the file with whatever program is designated to open that type of file. For Windows, the **View** button enables when **Is URL** is selected and the **URL/File** field is not empty, or **Is URL** is not selected and the **URL/File** field indicates a path (contains backslashes or begins with `./`). The same conditions apply on Linux systems. In addition, on Linux, the `view.properties` file must be in the SIMPROCESS working directory, and the `view.properties` file must contain valid `url.view` and `file.view` properties. Due to other applications being required, the **View** button is not guaranteed to work in every case. (The SIMPROCESS working directory is in the user's home directory. On Linux it is typically the directory `/home/username/SIMPROCESS` where `username` is the account user name.)

- **Attributes** define custom attributes that the Activity requires. This topic is covered extensively in "Customizing a Model with Attributes and Expressions".

- **Expressions** allow customized processing for the Activity at various points during a simulation. This topic is covered in detail in "Customizing a Model with Attributes and Expressions".

- **Event Logs** are used for defining timestamps and recorders.

- **Text Block** is a description that appears within the Activity's icon on the layout.

- **Counts** are used for setting Activity count display options.

- **Help** displays information about the Activity.

The following tabs and fields are found on most Activity Properties dialogs:

- **Resources** defines the Resources required to process Entities arriving at the Activity. The Entity waits in a queue until the Resource or Resources can be obtained.

- **Duration/Value** is the amount of time it takes the Activity to process an Entity, once the required Resources are obtained. Time can be defined as a constant, or as a statistical distribution.
- **Duration/Time Units** specifies the units and measure for duration time in nanoseconds, microseconds, milliseconds, seconds, minutes, hours, days, weeks, months, or years.

The following buttons are found on all Activity Properties dialogs except Background Text. These buttons allow the creation of items that are then available throughout the model.

- **New Entity** creates new Entity types.
- **New Resource** creates new Resource types.
- **Entity** creates new global Entity instance attributes.
- **Entity Type** creates new global Entity Type attributes.
- **Resource** creates new global Resource attributes.
- **Model** creates new Model attributes.

Attributes are covered extensively in "Customizing a Model with Attributes and Expressions".

## Naming Activities

Use the **Name** field to assign a name to an Activity. This name is shown below the Activity icon in the model if the **Show Name** checkbox is selected.

SIMPROCESS assigns new Activities a default name. It is a good idea to change this to a name that is meaningful; one that indicates what occurs at this Activity. Activities can be named just about anything, as long as the same name is not used twice in the same level of the model hierarchy.

Change the name of an existing Activity by clicking in the **Name** field and typing the new name.

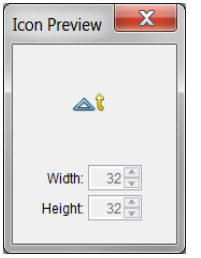
The contents of the **Text Block** can be used as the **Name** by selecting the **Use Text Block** check box. The lines of text are appended together with a space between each line to create the **Name**. When **Use Text Block** is selected, the **Name** field is not editable. The values on the **Text Block** tab must be changed to change the **Name**.

## Choosing an Icon

The **Icon** field identifies the graphical icon used to represent the Activity in the model layout. All Activity icons are arranged into sets. The set consists of predefined sets and user defined sets. (See

"Importing Graphics Image Files" on page 202.) The **Icon Set** field lists the sets of icons available. The set **All** lists all icons regardless of set. Every Activity has several icons from which to choose. The names of the standard icons differ slightly for each Activity, because they include the name of the Activity.

Point and click on and icon's name to select it. The icon button on the right shows the default size of the icon. Click the icon button to see the actual size.




GIF, JPG, and PNG files may be imported and used as custom icons for Activities.

## Adding a Comment

Use the **Comment** field to add a brief comment describing the purpose of this Activity. This field is optional. Printing **Process Documentation** or **Model Documentation** will include comment in the document. The comment will appear on the status bar when an Activity is selected.

## Documenting the Activity

The **Document** button opens an editor in which descriptive information may be added about the Activity. The editor opens with a preformatted template which is changeable. (See "document Subdirectory".) Print **Document** text using the SIMPROCESS Print facility.

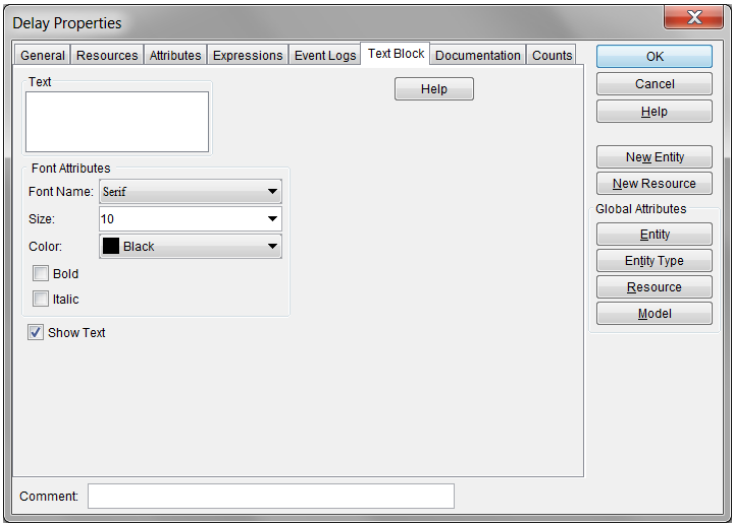
## Labeling with Text Blocks

The Text Block tab adds text to the inside of the icon on the layout.

Text Block labels facilitate understanding of the Activity or Process in relation to the model.

Add descriptive labels to an icon by performing the following tasks:

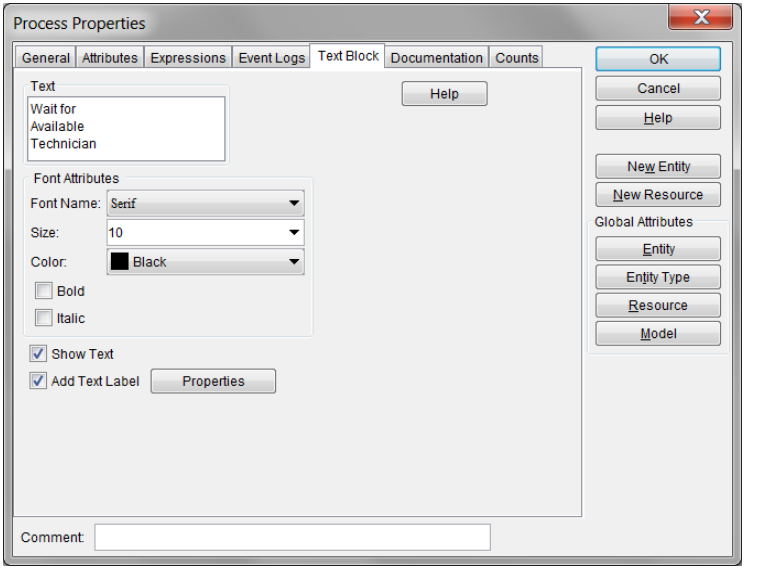
1. Click on **Text Block** tab:



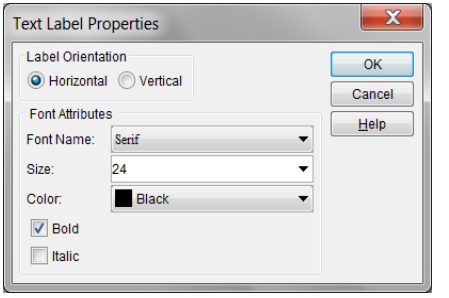

2. Fill in the text. Press Return at the end of a line to create a new line of text. The text will not automatically wrap when displayed; thus, the text can extend past the border of the icon. Also, there is no limit to the number of lines of text; however, three lines of text are optimal as the text may display above and below the icon if more than three lines of text are entered. Text beyond the horizontal or vertical bounds of the icon can be adjusted by removing text, changing **Font Attributes**, resizing the icon, or some combination of all three.
3. Set the desired **Font Attributes**.
4. *Make sure the* **Show Text** *box is checked*. The text entered is not displayed in the model unless this box is checked.
5. Click on **OK**.

**Note**: The **Text Block** is best used with blank box icons. Icons with a picture on them may not show the **Text Block** properly.

Process properties include an additional option on the **Text Block** tab. The **Add Text Label** check box places a label that contains the text of the **Text Block** inside each alternative of the Process.




The lines of text are appended together with a space between each line to create the label. Select the **Properties** button to set whether the label should be displayed horizontally or vertically and to set the **Font Attributes** of the label.




The label will be centered across the top of the layout when **Horizontal** is selected, and the label will be centered along the left of the layout when **Vertical** is selected. Note that the labels cannot be resized or moved. Changes can only be made from the **Text Block** tab of the Process properties dialog. Defaults for **Horizontal** or **Vertical** and the **Font Attributes** can be set on the **Text Label** tab of the Preferences dialog (**Edit/Preferences**).

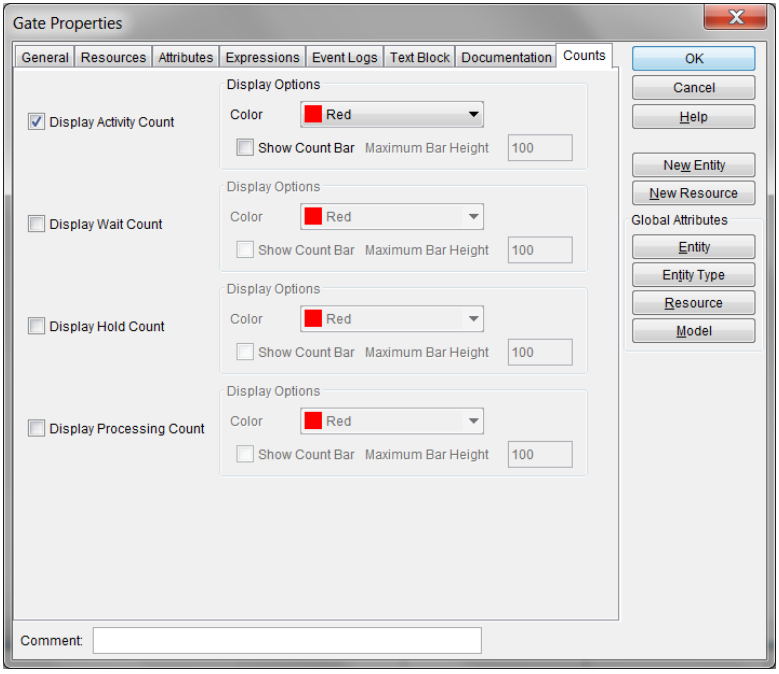
## *Setting Activity Count Options*

The **Counts** tab allows customizing of the Activity counts.

All Activities will have settings for Activity Count. **Display Activity Count** turns the display of Activity Count on and off. (All counts are hidden if **Show Counts** is not selected. See "Animation Settings…," beginning on page 65 for more information.) When selected the **Color** of the count and its optional count bar can be specified. If **Show Count Bar** is selected, a vertical bar will display showing the relative value of the count. **Maximum Bar Height** is the maximum value that will be displayed by the vertical bar. If the count goes above the maximum the actual count value will display, but the vertical bar will not change.

If an Activity can have a **Duration** and can have Resources assigned, there will also be the options **Display Wait Count**, which represents the number of Entities waiting for Resources at the Activity, and **Display Processing Count**, which represents the number of Entities processing at the Activity. If the Activity can hold Entities in any type of queue, there will be the option **Display Hold Count**, which represents the number of Entities holding for a condition at the Activity.

Below is the **Counts** tab for a Gate Activity. It has all four options.



## Getting Help

The Help button displays information about the purpose of the Activity and the fields and buttons on the **General** tab of the dialog. The other tabs have Help buttons that are specific to that tab.

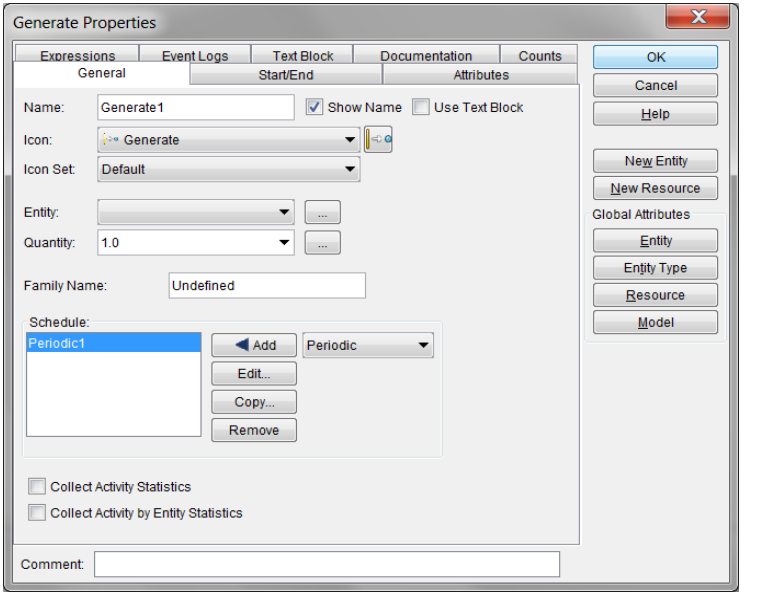
# Generate Activity

Generate Activities create Entities for a model during a SIMPROCESS simulation. Generally, the first Activity defined in the model is a Generate.

SIMPROCESS generates Entities at the rate defined in the Generate Activity. Entities can be generated at a constant number and rate, such as a specified interval of time, or according to a statistical distribution. The schedule of generation can be as simple as one constant rate, or as complex as dozens of different rates depending on the hour of the day, day of the week, season of the year, etc.

A Generate Activity can generate one or more types of Entities

## *Defining a Basic Generate Activity*




Click on the **Entity** pull-down arrow to select the default type of Entity to be generated by this Generate Activity. The default Entity type can be overridden in each schedule.

Entities may be defined using the **New Entity** command button on this dialog.

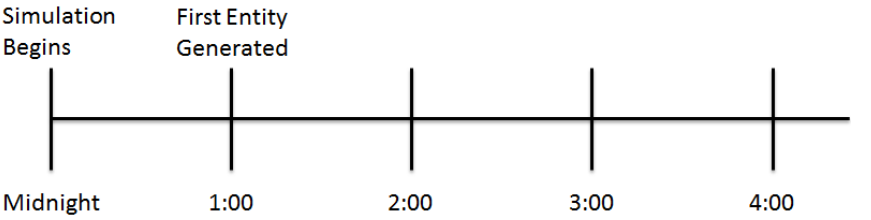
Use the **Quantity** field to specify the default number of Entities to be generated each time Entities

are released. A specific number or probability distribution can be entered in the **Quantity** field or a selection may be made from the **Quantity** pull-down list. The default quantity can be overridden in each schedule.

**Family Name** may be used if there are multiple Connectors exiting the Generate. See "Multiple Generate Connectors" for more information.

A periodic schedule is the default schedule. The periodic schedule sets the interval and the time unit. It will default to an interval of 1.0 and time unit of Hours. These defaults can be changed by selecting the schedule (Periodic1) and choosing **Edit**. Change the name of the schedule, override the default Entity type and quantity, and set the interval and time unit with this method.

The **Interval** field defines the time between Entity generation events. Enter a constant value or a statistical distribution. Entities are generated at the end of each interval:



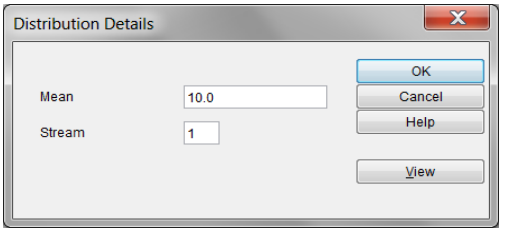

Entity Generation at Interval of 1 Hour

For example, assume Customer Orders to arrive at an exponential rate, with an average of 20 arrivals per hour. Click on the **Interval** pull-down arrow and find the definition for Exponential Distributions. It reads:

**Exp(10.0)**

Select the distribution. Then, click on the details button to the right of the pull-down arrow.

This displays a dialog for defining the parameters of the distribution:

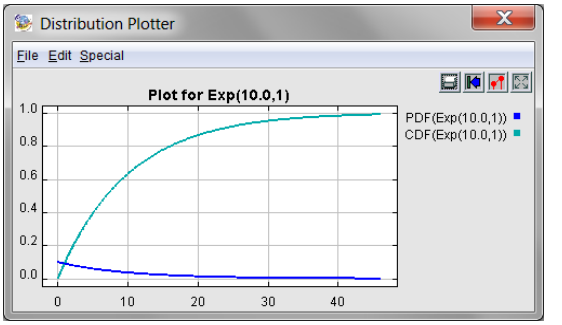


Set the **Mean** value to indicate an average Entity generation rate of 20 per hour.

Assume that Quantity is 1, meaning that only one Entity is produced at each Entity generation event:

- Generate an Entity every 3 minutes to get 20 Entities in an hour (60 minutes).

The **View** button displays a graphical representation of the distribution:

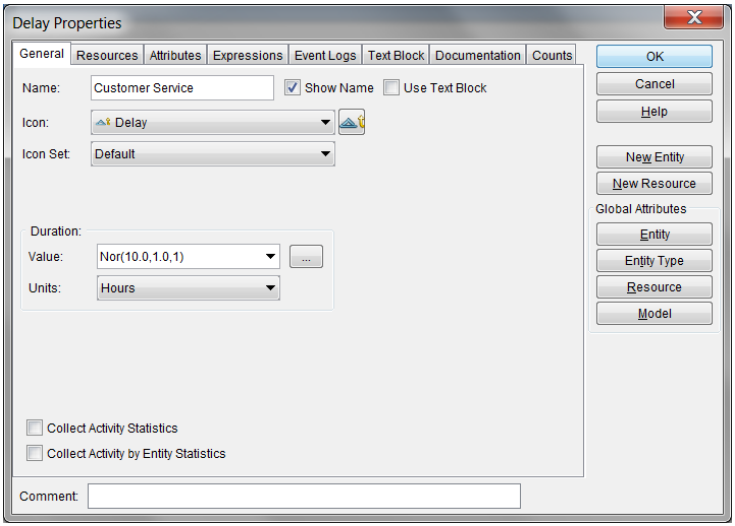



**Stream** identifies the random number stream used to seed the distribution.

More can be learned about statistical distributions and random number streams in Chapter 3, “Statistical Modeling Constructs,” beginning on page 114.

# Delay Activity

Delay Activities, common building blocks found in most models, have two functions: they represent the passage of time during simulation and define the Resources required to perform a task. The cycle time of an Entity traversing the model is the sum of the delays it encounters, i.e., the time spent at the Activities in its path, time spent traversing Connectors, any hold time for a condition to be met, and the wait time for any Resources.




The **Resources** tab is where the Resources required to perform an Activity are specified. See Chapter 5, “Resource Modeling Constructs,” beginning on page 181 for instructions on defining Resource requirements for an Activity.

### *Specifying Delay Duration*

**Value** represents the amount of time required to perform an Activity. This delay time can be expressed as either a constant value or a statistical distribution.

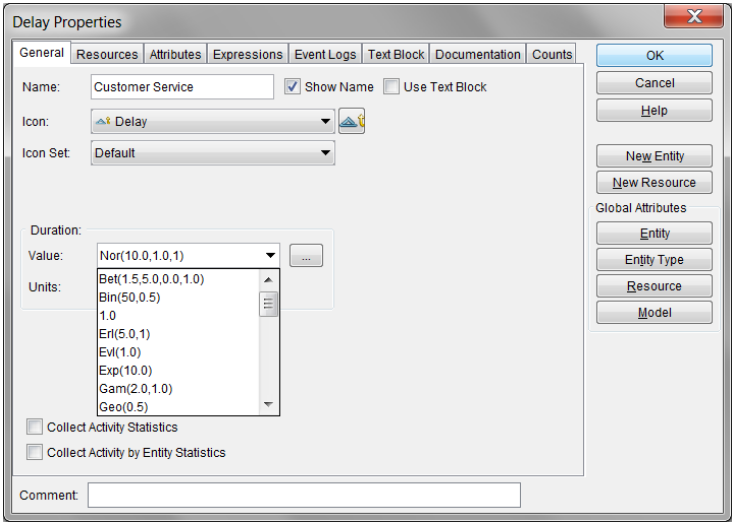
Time **Units** determines if the **Duration** entered is measured as nanoseconds, microseconds, milliseconds, seconds, minutes, hours, days, weeks, months, or years.

Type the value of the delay duration directly in the field, or select a value from a pull-down list.

A Delay Activity might be defined to represent the task of processing an order. This task takes an average of 30 minutes to perform, though it may take as little as 15 minutes, or as much as 1 hour.

As shown below, a Triangular distribution is often used to represent the time required to complete a task:

1. Click on the arrow to the right of the **Value** field to display a list of distributions:

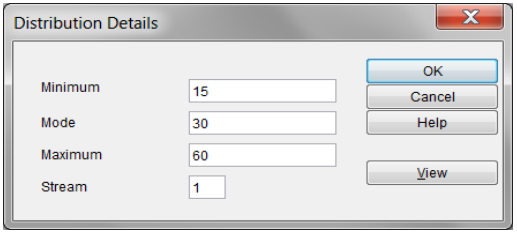



2. Scroll through the list to find the default definition for Triangular distributions. It reads:

   **Tri(0.0,5.0,10.0)**

   Select the distribution.

3. Click on the box to the right of the **Value** field. Fill in the following values: **Minimum** of 15, **Mode** of 30, and a **Maximum** of 60.




4. Click on **View** to see what the curve looks like.

5. Click on **OK** to accept the definition.

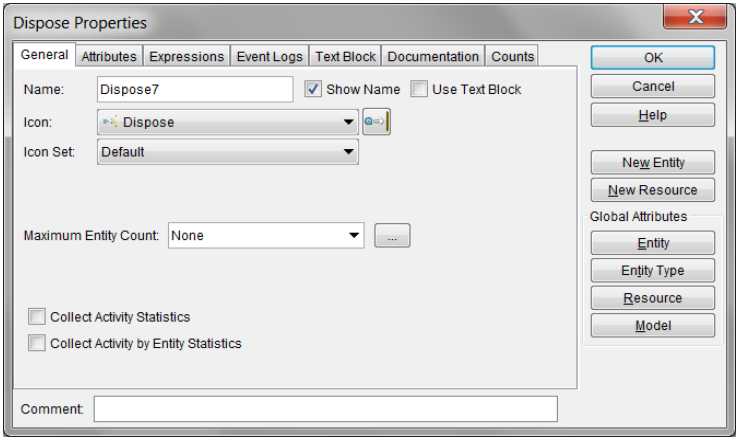
6. Select Minutes from the **Units** field.

See Chapter 3, “Statistical Modeling Constructs,” beginning on page 114 to learn more about these parameters and the topic of statistical distributions.

# Dispose Activity

A Dispose Activity disposes of Entities when they are no longer needed in the simulation. The Dispose marks the end of an Entity's cycle time for the purpose of statistic collection (e.g., cycle times and counts).

### *Dispose Activity Properties*




The **Dispose Activity Properties** dialog contains only one unique field: **Maximum Entity Count**. Use this field to set a limit to the number of Entities that can be disposed of at the Dispose during a simulation. The simulation ends if this limit is reached. End a simulation after 1,000 customer orders are processed by setting **Maximum Entity Count** to 1,000.

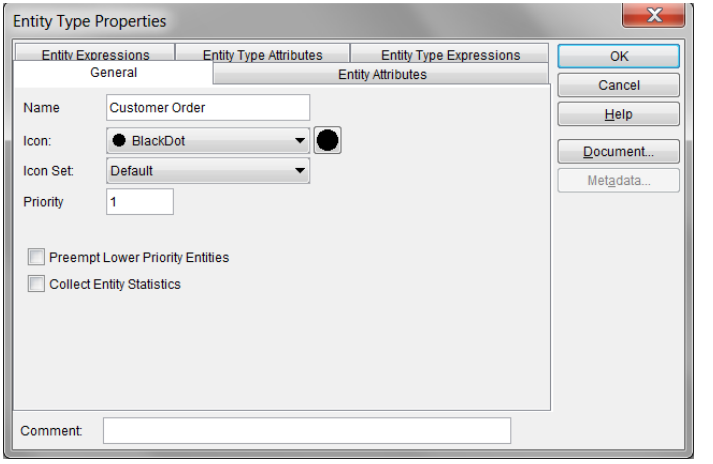
Leaving **Maximum Entity Count** undefined or setting a value of 0 or "none" indicates that there is no limit.

# Defining an Entity

A particular *type* of Entity or a particular *instance of* an Entity may be referred to in the model. When an Entity type is referred to, all Entities of a particular type, e.g., customer orders are also referred. An Entity instance refers to an individual Entity (a single customer order).

Defining Entities in SIMPROCESS defines a type; SIMPROCESS generates instances of that Entity during a simulation run. Define Entities in the following manner:

1. Click on **Define** on the SIMPROCESS menu, and then select **Entities...** from the pull-down menu or click on the **Define Entities** button on the Model Toolbar.
2. Click on **Add** to define a new Entity.




3. Specify the **Entity Type Properties**:

   - Entity **Name** identifies the type of Entity. **Name** can be any unique entity name.

     Double-click on the default name supplied by SIMPROCESS, and enter **Customer Order** as the Entity **Name**.

   - Entity **Icon** is the icon which will represent this Entity during a simulation run. The icon appears during simulation if the **Animation** option is on. Click on the downward-pointing arrowhead next to the Entity **Icon** field to get a list of different icons to choose from the currently selected **Icon Set**.

   - **Priority** values range from 1 to 100. When Entities contend for the same Resource, the Entity with the highest priority gets precedence.

- **Preempt Lower Priority Entities** sets whether instances of this type will preempt lower priority Entities. If true, when an instance of this type reaches an Activity that uses Resources and there are no Resources available, and the Entity currently using the Resources is a lower priority Entity, this higher priority arriving entity instance will cause the lower priority Entity to release the Resources so this Entity can obtain the Resources and Process.

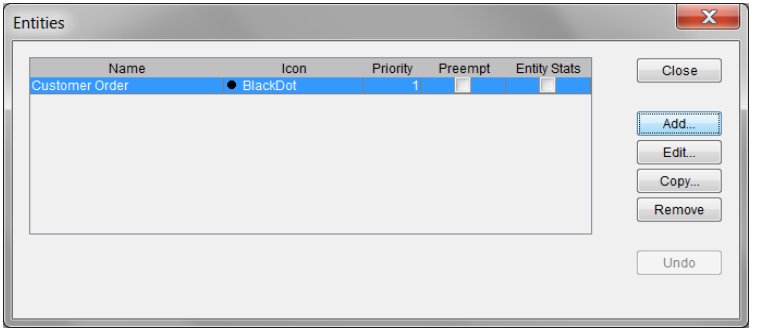
- **Entity Attributes**, **Entity Type Attributes**, **Entity Expressions**, and **Entity Type Expressions** are used in association with any attributes or expressions defined for this Entity. A choice can be made to create a new copy of an attribute or evaluate an expression every time an instance of an Entity is created. Alternatively, one copy of an attribute can be created or an expression evaluated once for an Entity type and have all instances refer to this value. Attributes and expressions are discussed in "Customizing a Model with Attributes and Expressions".

- **Document...** opens an editor window into which extensive comments can be entered about the Entity and the model. This is optional. The Entity document headings can be customized. (See "document Subdirectory".)

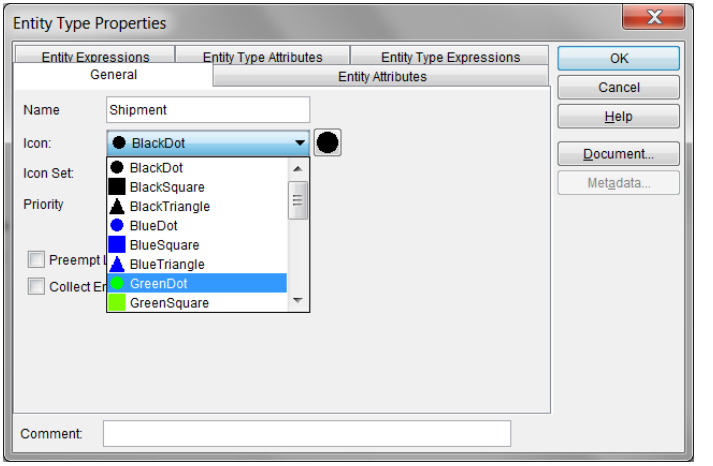
- **Metadata...** opens a dialog for metadata entry. See the *SIMPROCESS Metadata Manual* for information on using metadata in a SIMPROCESS model.

- **Comment** is used to enter brief text describing the purpose of the Entity.

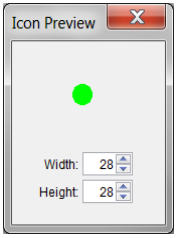
4. Click on **OK** when data entry is completed. The defined Entity is added to the table in the **Entities** dialog.

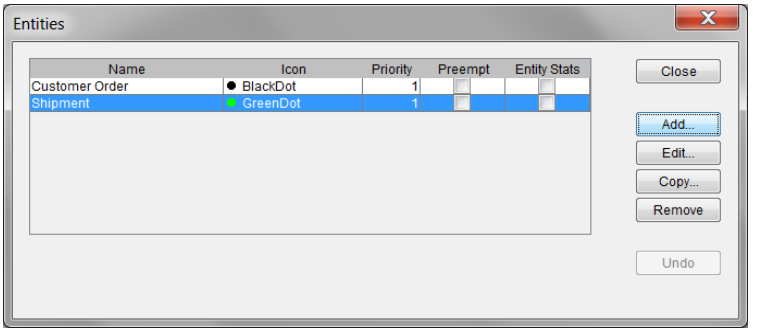



5. Add another Entity and name it **Shipment**. Click on the pull-down arrow next to the **Icon** field to get a list of Entity icons.




The list may be a lot longer than it first appears. Click near the top of the scroll bar to see more list items. Select *GreenDot*. Then click on **OK**. The icon selected will appear on the button next to the icon list. Clicking the button will bring up a dialog that shows the display size of the icon. The width and height used during a simulation can be changed. The minimum for width and height is 10 and the maximum is 100. A default size for Entity icons can be specified in the Preferences.






Note that the basic properties of Entities added to the model can be edited directly from the table. However, changes made in the table are direct changes to the properties of the Entity and cannot be canceled. Also, the table can be sorted by a particular column by clicking on the column header. Holding the **Shift** key while clicking on a column header causes the table to sort in the reverse order.

Copy the properties of an existing Entity (such as the one just defined) by selecting the Entity in the table and click on the **Copy** button. Enter a different Entity **Name** and make any other changes on the **Entity Type Properties** screen, and then click on **OK**.

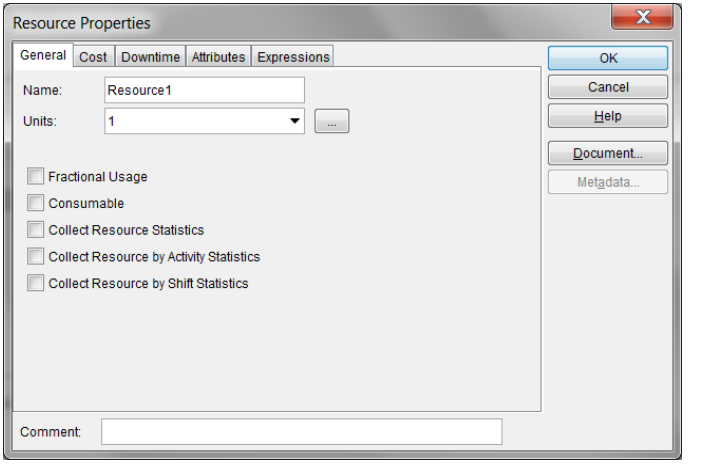
Remove an existing Entity by selecting the Entity and clicking on the **Remove** button. The **Undo** button restores Entity definitions that have been removed. Click on **Close** when Entities are defined.

# Defining Resources and Processes

## *Resources*

The next thing to define in the model are the Resources required to process Customer Order Entities. To keep things simple, define just one Resource, the clerks needed to process customer orders.

1. Select **Resources...** from the **Define** pull-down menu or click on the **Define Resources** button on the Model Toolbar.
2. Select **Add** to define a new Resource.




See Chapter 5, “Resource Modeling Constructs,” beginning on page 181 for an explanation of the remaining options and commands, and for more details on defining Resources, including pre-defined Resource types.

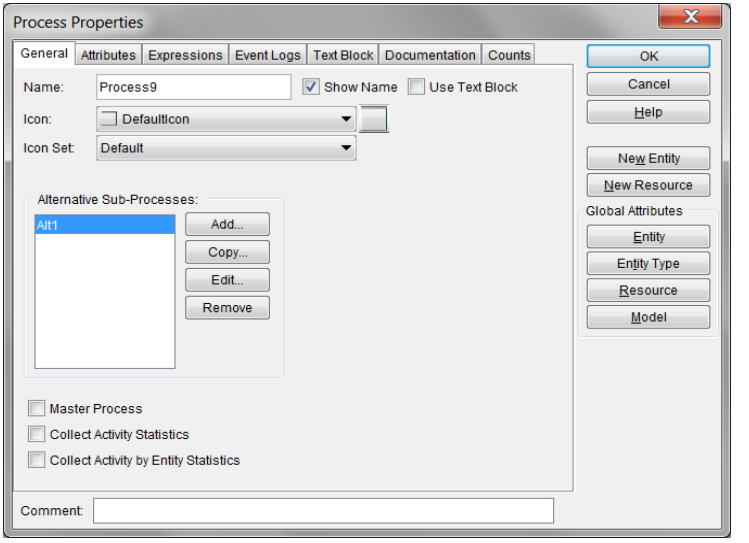
## *Processes*

A SIMPROCESS Process defines Processes hierarchically. In this example, we will define a Process that indicates how customer orders are handled

Select the **Process** button from the Model Toolbar and click on the layout.

Display a dialog for defining the Process. Do this by either:

- Clicking on the **Process** icon to select it, and then pressing **Alt+Enter**
- Selecting the **Process** icon, and then selecting **Edit** from the menu bar, followed by **Properties...**.




## *Alternative Sub-Processes*

A Process may consist of a set of Alternative sub-processes. Each sub-process can represent an alternative implementation of the Process. This allows the creation of many variations of a Process and keeps them organized in one place.

Only one sub-process can be active at any point in time. An experiment may be run with Alternative sub-process 1 active to measure the overall performance of the model. Alternative sub-process 2 can then be run and results compared.

SIMPROCESS defines a single default sub-process when a Process is created. Renaming the sub-process to something more meaningful for the model is accomplished by:

1. Selecting it from the **Alternative Sub-Processes** list on the **Process** dialog.
2. Clicking **Edit** to modify the sub-process definition.
3. Highlighting the existing name and typing over it. For this example, call the sub-process **Main**.
4. Click on **OK**.

The new name appears in the **Alternative Sub-Processes** list and becomes the active sub-process.

More sub-processes may be added to the Process by clicking on **Add** and naming the new sub-process. Activate a different sub-process by selecting it from the **Alternative Sub-processes** list.

Sub-processes may be deleted with the **Remove** command button and copied using the **Copy** button.

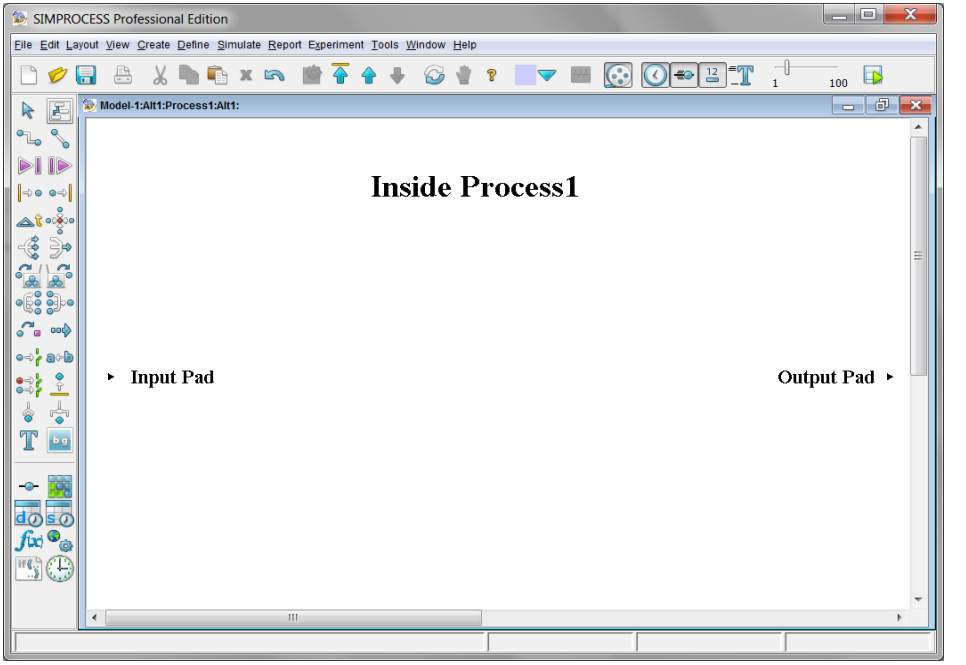
Click on **OK** when the **Process** is defined.

## *Adding Detail to a Process*

Once a Process is defined, define the Activities and Processes that make up the Process.

Right-click on the **Process** icon and choose **Descend** to open the layout of the currently active sub-process.

A blank layout is shown, except for two Pads: an input Pad on the left and an output Pad on the right. If the output Pad is not visible, scroll to the right.



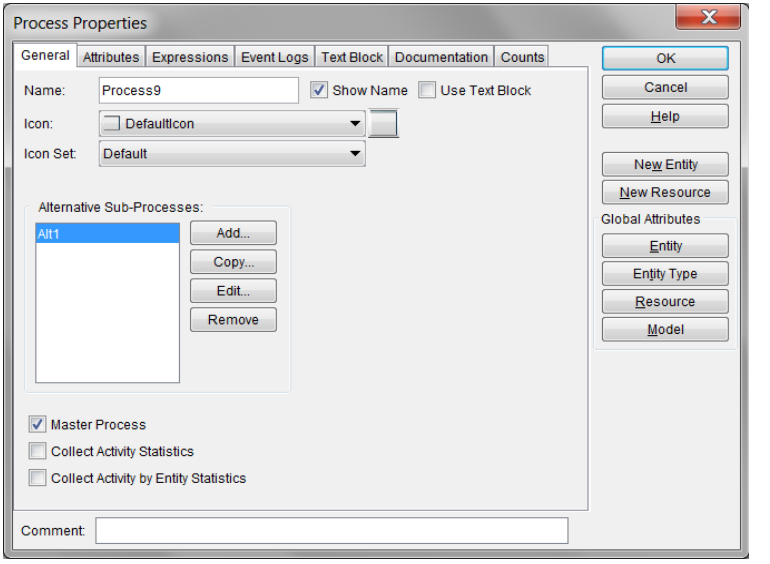

These Pads connect any Processes and Activities at this level of the sub-process to the Activities and Processes at the next higher level. Once the input and output Pad are connected by Connectors, Entities flow from level to level.

Activities (and Processes) may be added within the sub-process to detail the tasks being performed.

**NOTE:** Make sure the Input and Output Pads are connected on all sub-processes. If this is not done, Entities will have no path to follow across the Process. Entities entering the Process will never emerge again.

## *Master Processes*

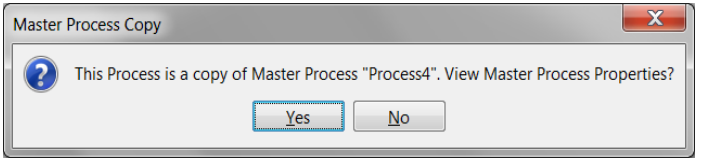
A hierarchical Process can be designated as a Master Process. If a Process is designated as a Master Process, any copies of the Master Process pasted within the same model are linked to the Master Process. Any changes made to the Master Process can be applied to all the copies of the Master Process. Copies of a Master Process cannot be edited. Select **Master Process** on the Process properties to designate a Process as a Master Process.




When **OK** is selected and there are no copies of the Process, the Process is simply marked as a Master Process. If there are copies, the copies are updated with all property changes and with any changes made within the Process (such as addition or deletion of Activities). Copies of a Master Process can also be updated by right clicking on the Process and choosing **Master Process/Update Copies**.

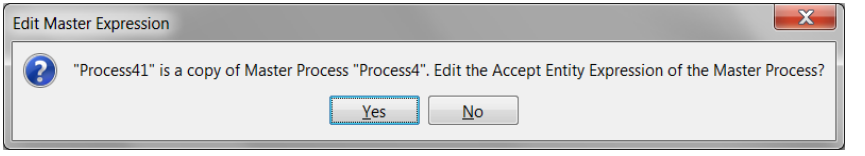
If **Master Process** on the Process properties is deselected, when **OK** is clicked the copies of the Master Process will lose their link to the Master Process. At this point, the copies can be edited and changed. A single copy can be unlinked from the Master Process by right clicking on the Process and choosing **Master Process Copy/Remove Master Link**.

The contents of a copy of a Master Process can be viewed, but no changes can be made to the contents. The properties of Activities and Processes within the copy can be viewed but any changes cannot be saved; however, the properties of a copy of a Master Process cannot be viewed. If **Properties** is selected for a Master Process copy, an option to view the properties of the Master Process will be displayed.



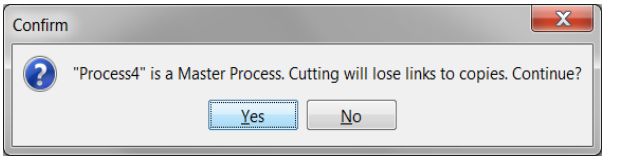

The names of all Activities and Processes within a Master Process copy are modified so the names are different from the corresponding Activities and Processes in the Master Process. A number is appended to each name based on the number of the copy. For example, for the first copy of a Master Process, 1 is appended to each name. The second copy of the Master Process appends 2 to each name. Any Activity or Process names in the copy referenced in Expressions of the copy are updated with the new names. Errors may occur if other parts of the Expressions also match names that were changed. For example, if the System Attribute `NumberDisposed` is referenced in an Expression, avoid naming a Dispose Activity “Dispose”. When “Dispose” is changed to “Dispose1” for the copy, `NumberDisposed` will be changed to `NumberDispose1d`.

Process Expressions can be edited by right clicking on the Process and choosing the Expression to edit. If this is done on a Master Process copy, as with viewing the properties of a copy, an option to edit the Expression of the Master Process will be displayed.

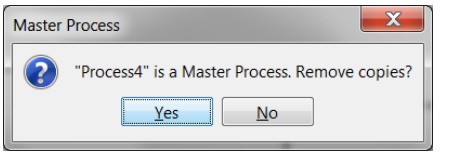

Edit Master Expression
"Process41" is a copy of Master Process "Process4". Edit the Accept Entity Expression of the Master Process?
Yes
No

The active alternative of a Process can be changed by right clicking on a Process. If the Process is a copy of a Master Process, the alternatives can be viewed but the active alternative cannot be changed. Changing the active alternative of a Master Process will change the active alternative of all copies.

If a copy is made of a Master Process copy, the pasted Process will also be a copy of the Master Process. If a Master Process is cut, the links to the copies will be lost even if the Master Process is pasted back into the model. A warning is displayed before the cut occurs.

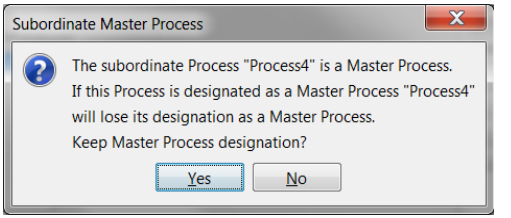



If a Master Process is deleted, an option will be offered to also delete the copies.

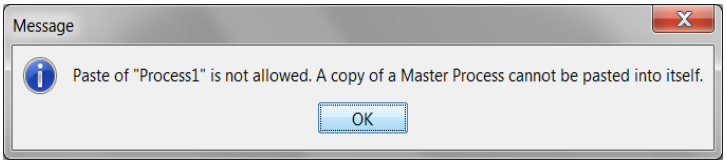


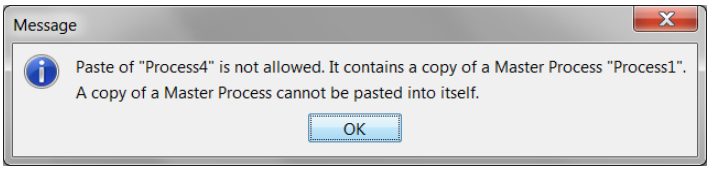

If the copies are not removed, the links to the Master Process are lost and are not restored even if the deletion of the Master Process is undone. However, if the copies are removed along with the Master Process, when **Undo** is selected the Master Process and copies at the same level as the Master Process are restored with the links intact. Note that if a copy is at a different level of the model from the Master Process, **Undo** must be selected at that level for the copy to be restored. The undo of the Master Process deletion should occur before the undo of any copy deletions at different levels. If a Master Process and a copy at the same level are to be deleted, only delete the Master Process and either choose to delete all copies or delete the copy separately.

There cannot be a Master Process within a Master Process. The Master Process option is disabled for child Processes of a Master Process. Also, if a higher level Process is designated a Master Process, a warning will display explaining that a child Process is a Master Process and that continuing will cause the child Process to lose its Master Process designation. If the option to continue is selected, the child Process does not actually lose its Master Process designation until **OK** is selected on the Properties dialog.


Subordinate Master Process
The subordinate Process "Process4" is a Master Process.
If this Process is designated as a Master Process "Process4"
will lose its designation as a Master Process.
Keep Master Process designation?
Yes
No

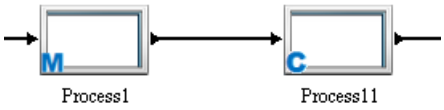
A copy of a Master Process cannot be pasted within the original Master Process. This is enforced even if the copy of the Master Process is embedded in another Process that is being pasted.





Message
Paste of "Process4" is not allowed. It contains a copy of a Master Process "Process1".
A copy of a Master Process cannot be pasted into itself.
OK

Items in Processes copied from a Master Process will display in the Activity Browser, Connector Browser, Model Search, Expression Search, Metadata Search, and other display options. However, those items will not be available for **Edit** or **GoTo**. The only exception is, for the Process that is the actual copy of the Master Process, **GoTo** is available (unless in an inactive alternative).

Master Processes and copies of Master Processes can be identified visually by selecting **Display Master/Copy Badges** in the SIMPROCESS Preferences (page 31). Master Processes will display an M at the lower left hand corner of the Process icon, and copies of Master Processes will display a C in the same location.



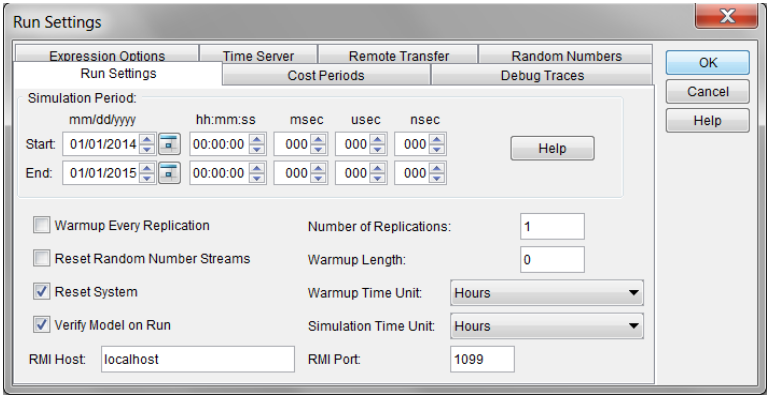
# Simulation Setup

Two steps are needed before running a simulation:

- Set the run time parameters for the simulation. This could include start and end dates or number of times to repeat the simulation.
- Set animation parameters.

## *Run Settings*

Select **Simulate** from the SIMPROCESS menu and then click on **Run Settings…** to set run time options.




### *Setting the Start and End Dates*

The values chosen for the **Start** and **End** fields determine how long the simulation runs, in calendar time. A simulated month of processing can be specified as:

**Start:** 1/1/2014 00:00:00:000:000:000

**End:** 2/1/2014 00:00:00:000:000:000

This indicates a starting date of January 1, 2014, at midnight, and an end date of February 1, 2014, at midnight. The simulation terminates as soon as the clock strikes midnight at the end of January 31. The calendar button next to each date field can be used to set the date for that field. The calendar button causes a graphical calendar to appear. The date selected on the graphical calendar populates the appropriate date field.

A time must be entered or the hours, minutes, seconds, nanoseconds, microseconds, and milliseconds fields default to zero.

**NOTE**

Remember that **Start** and **End** dates for objects in the model, must be coordinated those with the simulation run dates.

For example, a Generate Activity with **Start** and **End** dates that fall outside of the simulation **Start** and **End** dates will not generate Entities during the simulation. Or, a **Resource Downtime** with **Start** and **End** dates outside of the simulation **Start** and **End** dates will not be applied.

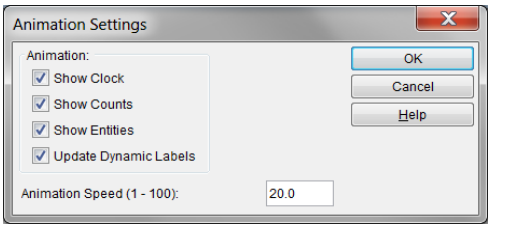
### *Run Dates and the Real Calendar*

Both Entity generation schedules and Resource downtime schedules can be based on a day of the week. SIMPROCESS calculates the day of the week, as well as the month, year, and time of day, at any moment in a simulation. It maps the simulation dates to the real calendar. For example, in 2014 the year begins on a Wednesday.

### *Setting the Simulation Time Unit*

SIMPROCESS allows the **Simulation Time Unit** to be set, which is the time unit of the simulation clock. The simulation clock must maintain a constant time unit. The default is *Hours*. Even though each individual time unit can be different, those times are converted to the time unit of the simulation clock. Also, this is important for reducing rounding errors. If the primary delays in the model are in seconds or less, the time unit of the simulation clock should be set to *Seconds* or less. Converting a delay in nanoseconds (or even seconds) to hours could result in rounding errors, whereas converting a delay in nanoseconds to seconds or less most likely would not.

## *Animation Settings*



**Show Clock** turns the simulation time clock on or off while the simulation is running.

**Show Counts**. If **Show Counts** is turned on, each Activity or Process may display one or more numbers and, optionally, vertical bars above its icon. The items displayed are set on the **Counts** tab of the Activity properties. (See "Setting Activity Count Options" for more information.)

- Generate Activities show the number of Entities generated.
- Dispose Activities show how many Entities have been disposed.
- All other Activities and Processes show how many entities are in that Process or Activity.

**Show Entities** turns the display of Entities on or off during the animation. Showing Entities assists with visualizing the workflow.

**Update Dynamic Labels** turns the display of dynamic labels on or off during the animation.

**Animation Speed**. Changes the **Animation Speed** during the simulation. The fastest value is 100, and the default is 20. A smaller value is better while debugging the model.

# Running a Simulation

Start the simulation running, either by clicking the run icon on the tool bar, or selecting **Simulate** from the SIMPROCESS menu bar, followed by **Run**.

Before starting the simulation, SIMPROCESS does two things:

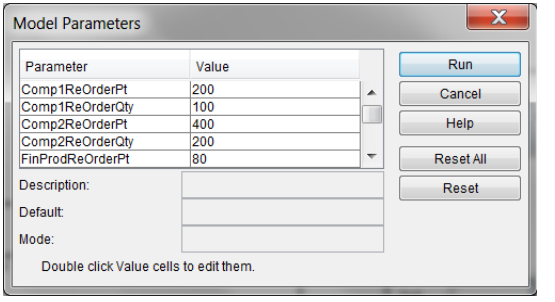
1. Prompts for saving the latest changes to the model
2. Checks the model for errors.

SIMPROCESS issues informational messages and aborts the simulation if errors are found.

Choose **Verify Model** from the **Simulate** menu before running to check the model for errors before running a simulation.

## *Running a Simulation with Model Parameters*

If the model has User-defined Attributes which were selected as Model Parameters, when the simulation run is started, SIMPROCESS will prompt for initial values for those Model Parameters.




The Model Parameters are displayed in a table. The column under **Parameter** gives the name of the User-defined Attribute. The **Value** column shows the value the attribute will have at the start of the simulation run.

To change the value of a Model Parameter, select it in the table. The Description of the selected parameter will be displayed below the table along with its default value and the mode of its value (integer, real, etc.)

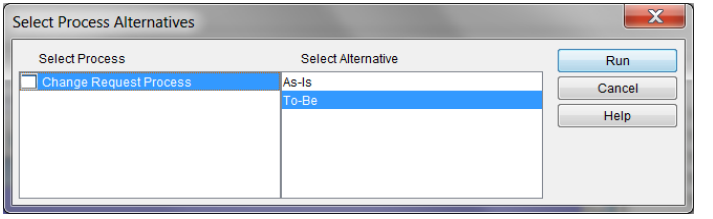
The next step is to enter the desired value of the Model Parameter in the **Value** field. If **Reset** is pressed, the selected Model Parameter will return to its default value. The **Reset All** button, under the **Help** button, will set the value of all the Model Parameters back to their defaults.

Creating Model Parameters from User-defined Attributes is covered in “Creating a User Defined Attribute”.

Model Parameters can be changed during a simulation run by selecting **Change Model Parameters** from the **Simulate** menu.

## Running a Simulation that has Processes with Multiple Alternatives

If the model has one or more Processes with multiple alternative sub-processes (see “Alternative Sub-Processes” on page 101), when the simulation is started SIMPROCESS will prompt for selection of the active sub-processes.

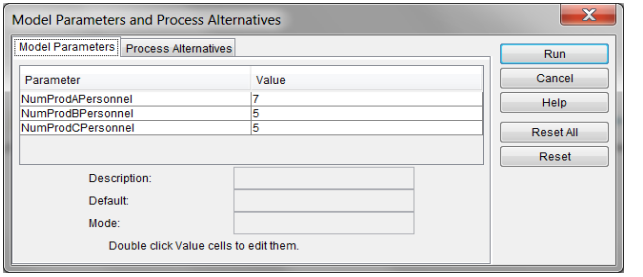



The Processes with multiple alternative sub-processes are displayed on the left. When a Process is selected the defined alternatives are displayed on the right. Select the alternative sub-process that should be active for the simulation. If a Master Process (page 103) has multiple alternatives, the copies of the Master Process will not be displayed. The selected alternative for the Master Process will be applied to all copies.

Simply click **Run** to accept the alternative sub-processes already selected in the model.

## Running a Simulation with Model Parameters and Process Alternatives

If a model contains both Model Parameters and Processes with multiple alternative sub-processes, SIMPROCESS will prompt for both on a single dialog with a tab for each.




## *Running a Simulation with Scenarios*

If the model has Scenarios defined and **Activate Scenarios** is selected on the **Simulate** menu, when the simulation run is started, SIMPROCESS will prompt for a run Scenario. See "Running Scenarios" for more information.

## *Allowable Actions During a Simulation*

While a simulation is running, a Process can be descended into to view Entity movement within the Process hierarchy. Descending into a Process is done by using **Descend** on the **View** menu, clicking the down arrow on the tool bar, right clicking on a Process and choosing **Descend**, or by double-clicking on a Process.

To ascend to a higher level of the model hierarchy choose **Ascend** on the **View** menu, click the up arrow on the tool bar, right click on blank area and choose **Ascend**, or double-click on any blank area of the model layout. Choose **Go To Top** instead of **Ascend** to ascend to the top level of a model.

The **Simulate** option on the menu bar causes the following options to occur:

- Pause the simulation
- Resume simulation after a pause
- Stop the simulation before its scheduled end
- Click on **Animation Settings** to change animation options. The simulation pauses while this is being done. Changing the animation options using the tool bar does not pause the simulation.

Double click on an **Activity** icon to bring up its properties dialog. However, any changes made will not be reflected in the running simulation.

Animation can be recorded for playback after the simulation ends. (See "Post Simulation Animation" on page 215.)

# Simulation Results

There are two options for quickly reviewing output statistics after a simulation run has completed: View Simulation Results and the Standard Report.

## *View Simulation Results*

Choose View Simulation Results on the Report menu. This displays a dialog that allows the selection of specific statistics to be viewed in a tabular format. Also, there are options for saving the results and viewing the results in various chart types. See "Simulation Results," beginning on page 229 for more information.

## *Standard Report*

After the simulation run has completed, the Standard Report may be displayed to view output statistics for the model. From the **Report** menu bar, choose **Display Standard Report**.

This will open the **Display Standard Report** dialog. In the **Report Replications** list box (if the model ran for multiple replications), select an individual Replication, the Average of All Replications run, or the Sum of All Replications run. Typically, the report of interest will be the Average of All Replications report. **Calculate Confidence Intervals** is activated if the Average of All Replications report is selected, which allows selection of 90%, 95%, or 99% confidence intervals for each performance measure. Select to view the Standard Report with a **Text Editor** (Wordpad by default), with a **Spread Sheet**, or with the **Report Viewer**, and press the **Display Report** button to open the report.

See "Standard Report," beginning on page 243 for more detail on the Standard Report.

CHAPTER 3

# *Statistical Modeling Constructs*

SIMPROCESS allows the analyzing of processes using discrete event simulation. This means that SIMPROCESS models systems by taking the processes that happen in the real world and breaking them down into the key events that occur. Parts move to a station in a factory, are processed, and then move to the next station. If one part goes into a station and one part comes out, then the most important aspect of modeling the station would be to capture the processing time (which, in the real world, will vary due to any number of factors) by a statistical distribution.

A statistical distribution is used to give the model the randomness that always occurs in the real world. Of course, if things in the real world never varied, simulation would not be needed! Mean-value analysis of your system would suffice. Mean-value analysis is a simple way of predicting system performance by looking only at average rates. Unfortunately, the real world almost never matches the performance predicted by mean-value analysis, because statistical fluctuations almost always need to be taken into account.

Expertise in statistics or modeling is not needed to use SIMPROCESS, though; just having some idea of how things vary is enough. If data shows it usually only takes 5 minutes for a clerk to process some paperwork, but it can take as long as 15, that is the beginning of a statistical model of that clerk. Exact answers are not necessary, just general behavior. Introducing a small amount of randomness through simulation can be all that is needed to transform a simplistic mean-value analysis into a realistic model.

SIMPROCESS provides a visual flow through the system, in addition to being able to model

processes' statistical nature. It is very difficult to know how people, machinery, deliveries, and resources are going to interact in a proposed system. SIMPROCESS shows how these interactions might occur while still in the planning stage. Animation provides valuable insight into how things work and how they could work.

# Random Number Generation and Standard Distributions

## Random Number Generation

SIMPROCESS contains 215 random number streams, each having a different random number seed. You can view the seeds by selecting **Seeds** on the **View** menu.

The purpose of using different random number streams in the model is to control variance. This is an advanced topic well beyond the scope of this manual. Please refer to texts on statistics and randomness, including *Simulation Modeling and Analysis* by Law and Kelton (McGraw-Hill).

SIMPROCESS offers two types of random number generation: Legacy and Mersenne Twister. The Legacy random number generator is the default random number generator. It is the same random number generator used in CACI's Simscript product. Mersenne Twister is a random number generator developed in 1997 by Makoto Matsumoto and Takuji Nishimura. The random number generator to use is set on the **Run Settings** (see "Random Numbers" on page 146).

## Standard Distributions

SIMPROCESS includes many standard probability distributions, and you can also create empirical distributions from your own data. Some of the probability distributions have more than one implementation. SIMPROCESS includes 11 distributions from the Apache Commons Math library (see commons.apache.org/proper/commons-math/). These distributions include ACM in the distribution name (see "Statistical Distributions" for a list).

The following paragraphs discuss selecting distributions and provide brief descriptions of some of the most common standard distributions.

### Choosing the Right Distribution for Your Data

It is not always clear which of the standard distributions should be used. Fortunately, simulation results are usually not highly dependent on the choice of distributions. A distribution with approximately the right shape should be adequate.

ModelFit, which is used with the Auto Fits feature, fits distributions to empirical data. (See "Auto Fits Distributions" on page 121.)

### Common Distributions

Poisson: Used to model the number of arrivals where the quantity within a time frame is known. Parameter: Mean.

Exponential: Used to model the time between arrivals. Parameter: Mean.

Normal: Bell-shaped curve; avoid when mean is near zero. Also, the normal distribution is not usually a good distribution for service times since service times are usually skewed to the right. Parameters: Mean, Standard Deviation

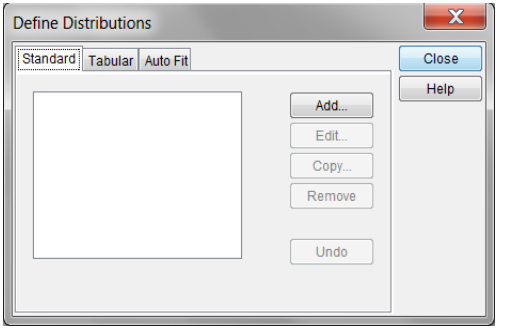
Lognormal: Can be good distribution for data that is skewed. Parameters: Mean, Standard Deviation

Triangular: Useful distribution for data that has the least amount of time, the most likely time, and the most amount of time it takes to perform a task. Parameters: Minimum, Mode, Maximum

A complete listing of the statistical distributions available in SIMPROCESS is available in Appendix D. See “Statistical Distributions”.

# User Defined Distributions

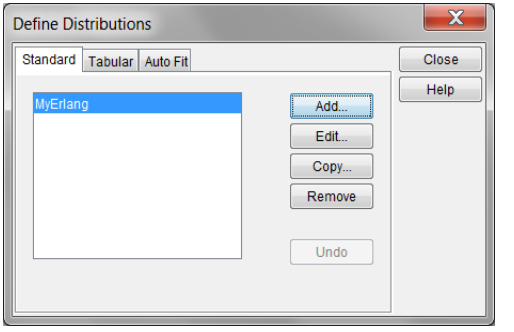
Selecting **Distributions...** on the **Define** menu offers three methods for creating **User Defined Distributions**. The first, **Standard**, customizes an existing SIMPROCESS distribution. The second, **Tabular**, creates a statistical distribution from discrete data points using a table format. **Auto Fit** automatically fits a distribution from sample data at the beginning of a simulation. The sample data can be in an ASCII file, spreadsheet, or database. ModelFit is used to perform the distribution fitting. (See **Help/About SIMPROCESS...** for information on ModelFit.) Note that the Auto Fit feature is licensed separately from SIMPROCESS.




These **User Defined Distributions** can be used anywhere in the model where a statistical distribution is specified.

## *Standard Distributions*

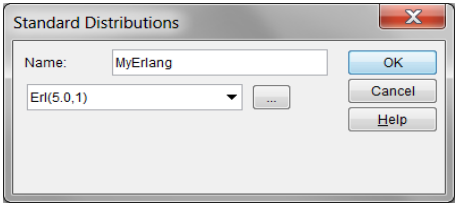
1. Select the **Standard** tab to **Add, Edit, Copy**, or **Remove** Standard Distributions. **Undo** retrieves a distribution that has been removed.



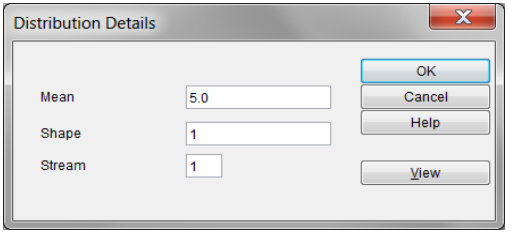
2. Choosing the **Add**, **Edit**, or **Copy** button brings up another dialog as shown below, where you type in the **Name** and distribution:

   **Name** is any non-blank user distribution name. It must be unique across all Distributions, Input Sources, and Functions.

   Select a distribution for modification.




3. Using the distribution text box, either change the parameters of the distribution within the parentheses or select the details button (three dots). This button opens a dialog containing the parameter descriptions, e.g., Erlang parameters.

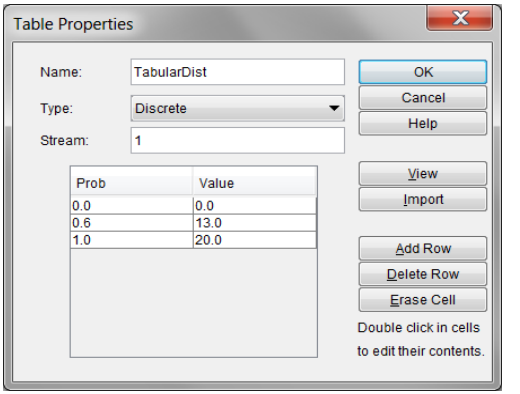



4. To see the PDF (Probability Distribution Function) and CDF (Cumulative Distribution Function) plotted, choose the **View** button from the dialog shown in Step 3. The PDF is labeled on the left y-axis, the CDF on the right y-axis.
5. The graph can be saved to a file. To continue, select **Close** from the graph's **File** pull-down menu.
6. Once the data is entered, choose **OK**, and the defined User Distribution is added to the list box. This User Defined Distribution can now be used anywhere in the model where a statistical distribution is specified.
7. To copy an existing User Distribution, select the distribution, choose the **Copy** button, and you can enter another **Name** for the distribution.
8. To remove an existing User Distribution, select the distribution, and choose the **Remove** button.
9. Choose another tab or the **Close** button if finished with User Distributions.

## *Tabular Distributions*

Tabular Distributions creates a statistical distribution from a table of discrete data points.

1. Select the **Tabular** tab. Use this tab to **Add, Edit, Copy**, or **Remove** Tabular Distributions.
2. Choosing the **Add**, **Edit**, or **Copy** button brings up another dialog as shown below:




3. Type in the **Name** any non-blank User Distribution name. It must be unique across all Distributions, Input Sources, and Functions.
4. **Type** is selected from the list box. Choose either a **Discrete** or **Continuous** probability distribution function. If **Discrete** is chosen, only the exact values indicated in the right column will be chosen when the distribution is sampled. If **Continuous** is chosen, SIMPROCESS will interpolate from the specified **Values** and the probabilities associated with them.
5. To update the table, point and click on the cell you wish to modify. Type the number in the table cell directly.

   Rows may be added and deleted by clicking on a cell and then choosing the appropriate button on the right. The row will be added above the one selected. The **Erase Cell** button causes the entry in the selected cell to be erased.

   A table may also be populated by importing data from a text file using the **Import** button.

   Choose the **View** button to see the PDF and CDF plotted. The graph can be saved to a file. Select **Close** from the graph's **File** pull-down menu to continue.
6. Once the data is entered, choose **OK,** and the Tabular Distribution is added to the list box. This Tabular Distribution can now be used anywhere in the model where a statistical distribution is specified.
7. To copy an existing Tabular Distribution, select the distribution, choose the **Copy** button, and enter another **Name** for the distribution.

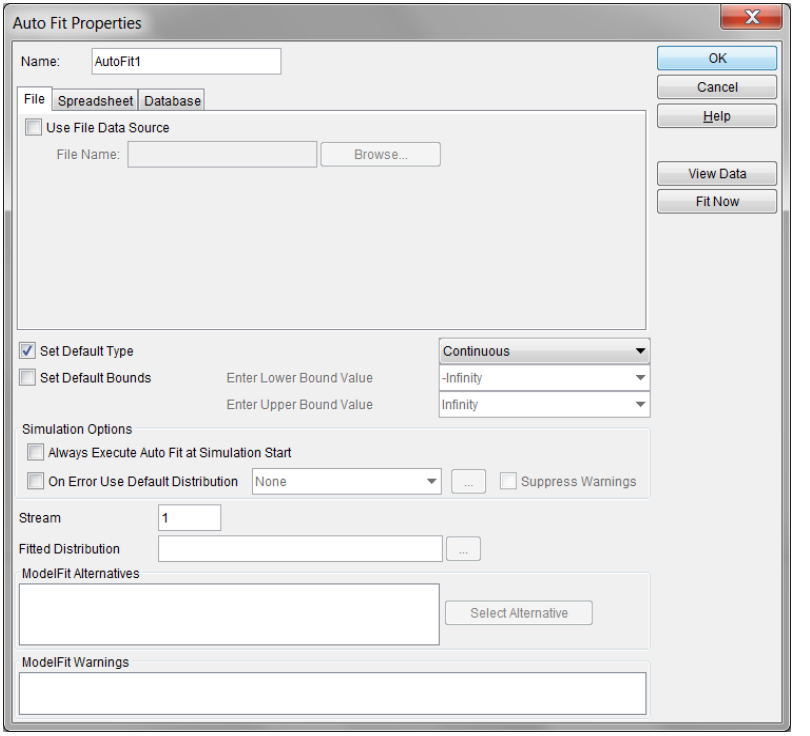
8. To remove an existing Tabular Distribution, select the distribution, and choose the **Remove** button.
9. Choose another tab or the **Close** button when the Tabular Distributions are complete.

## *Auto Fits Distributions*

### *Creating an Auto Fit Distribution*

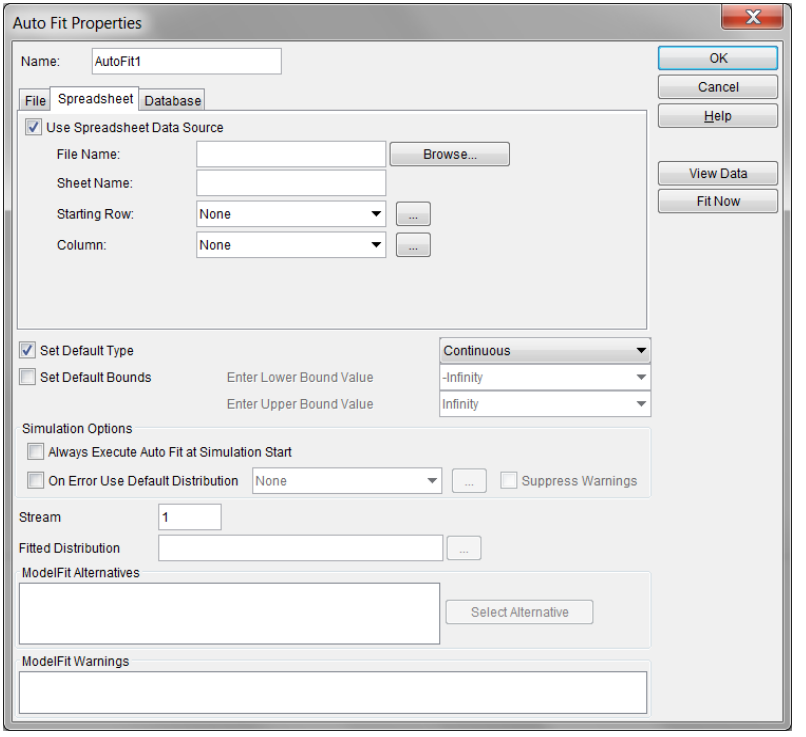
Auto Fits Distributions creates a statistical distribution from external sample data using ModelFit.

1. Select the **Auto Fit** tab. Use this tab to **Add, Edit, Copy**, or **Remove** Auto Fits Distributions.
2. Choosing the **Add**, **Edit**, or **Copy** button brings up another dialog as shown below:

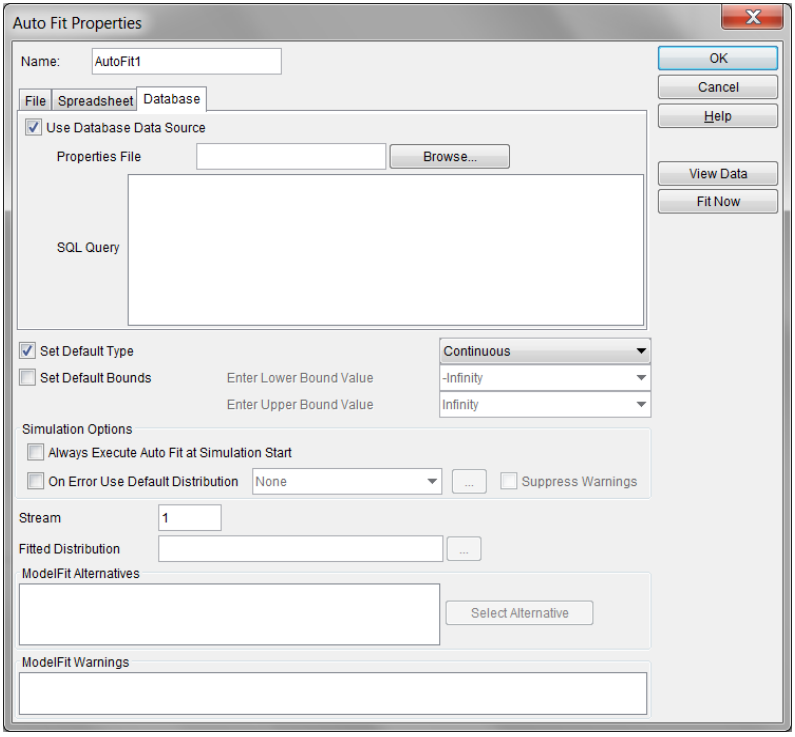



3. Type in the **Name** any non-blank User Distribution name. It must be unique across all Distributions, Input Sources, and Functions.

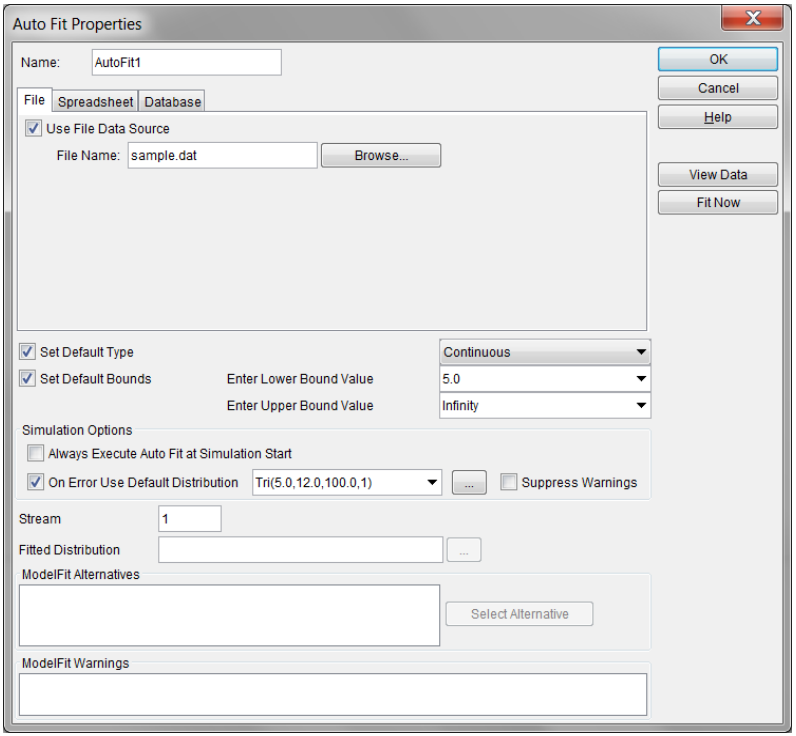
4. There are three tabs (**File**, **Spreadsheet**, and **Database**) that are used to specify the source of the sample data. One or more types of data source can be used. However, only one list of sample data will be fitted. Thus, if more than one data source is used, the data from all selected sources are combined into one list for distribution fitting.
5. The **File** tab is used to specify an ASCII file as the data source. **Use File Data Source** must be selected to use this type of data source. The **Browse** button can be used to locate the file. It is recommended that the file be located in the model's directory. Note that the file must contain a single column of numbers with no header and no non-numeric values.
6. The **Spreadsheet** tab specifies a spreadsheet as a data source. The Spreadsheet can be a Workbook file or an XML Spreadsheet. Once **Use Spreadsheet Data Source** has been selected, four fields are required: **File Name**, **Sheet Name**, **Starting Row**, and **Column**. The **Browse** button can be used to locate the spreadsheet file. Again, it is recommended that the file be in the model's directory. Enter the name of the worksheet in the **Sheet Name** field. **Starting Row** should have the row number (rows start with 1) that contains the first value. **Column** should have the column number (column A would be column number 1) of the sample data. The data must be in a single column with no empty cells. The data is read beginning at the **Starting Row** and continues until an empty cell is reached. Both **Starting Row** and **Column** are distribution list fields. Thus, the **Starting Row** and **Column** can be parameterized (such as `Evl(Model.StartingRow)` or `Evl(Model.Column)` where Model.StartingRow and Model.Column are Model Attributes designated as Model Parameters). A run-time error will occur if the specified **SheetName** does not exist. Also, if the spreadsheet is a Workbook and a cell is read that contains a formula, the formula is evaluated and the value returned. Note that not all spreadsheet formula functions are supported. A run-time error will occur if an attempt is made to read a cell that contains an unsupported formula. In an XML Spreadsheet, the value calculated by the formula will be returned if it already exists in the file; if not, a run-time error will result. Thus, in an XML Spreadsheet the formula is not evaluated at run-time.




7. The **Database** tab is used to specify an SQL database as the data source. **Use Database Data Source** must be selected to use this type of data source. Two items are required: **Properties File** and **SQL Query**. **Properties File** must contain the database location/connection information. It is the name of the properties file that contains the JDBC url and driver information and, if necessary, username and password. This file must be located in the model's directory. **SQL Query** must contain the query that returns the sample data. The query can be parameterized by using model attributes. For example, `"Select TIME_VALUE From TimeTable"` can be changed to `"Select Model.TableColumn From TimeTable"`. In this example, Model.TableColumn is a STRING Model Attribute that contains the name of the column to read. Note that if the query returns multiple columns, only the first column will be read for sample data.




8. Below the data source section of the dialog are two checkboxes: **Set Default Type** and **Set Default Bounds**. These checkboxes allow "hints" about the sample data to be passed to ModelFit. Information about the sample data can be useful in obtaining a proper distribution fit. If **Set Default Type** is selected (default), then either **Continuous** (default) or **Discrete** can be selected. For example, sample data representing time between arrivals is usually **Continuous**, whereas sample data representing number of arrivals is usually **Discrete**. If **Set Default Bounds** is selected, then the lower and upper bounds can be set and passed to ModelFit. **Enter Lower Bound Value** contains two selections: **-Infinity** and **0.0**. **Enter Upper Bound Value** contains one selection: **Infinity**. Other numeric values can be used as bounds by typing the values in the appropriate field. For instance, if the sample data represents task times, then there could be a minimum and/or maximum time to perform the task. Thus, the fitted distribution should reflect those times. In the example below, 5 is the lowest possible value that the fitted distribution should return. This means the task represented by the sample data has a minimum completion time of 5 (minutes, hours, etc.). Note that if neither checkbox is selected, then no information about the sample data is passed to ModelFit.

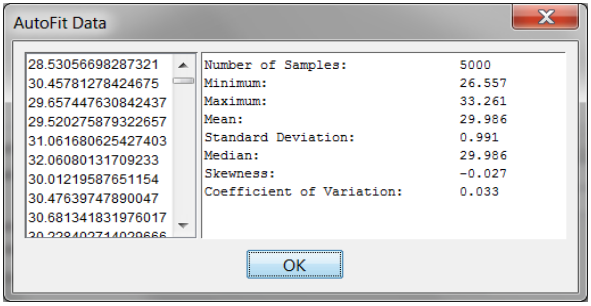



9. When selected, **Always Execute Auto Fit at Simulation Start**, causes the data sources to be read and the distribution to be fitted every time the model is run. Note that fitting will also occur at the beginning of a simulation if **Always Execute Auto Fit at Simulation Start** is not selected and the **Fitted Distribution** field is empty (**Fit Now** has not been executed). An error will occur at simulation start if distribution fitting is attempted, and the Auto Fit license has not been activated.

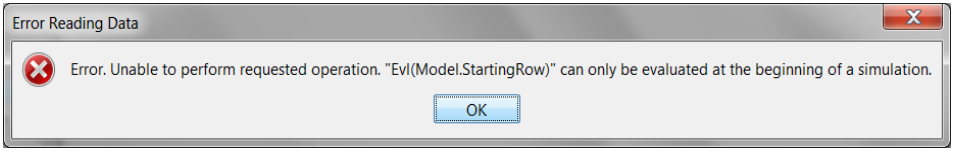
10. When **On Error Use Default Distribution** is selected, the associated distribution becomes enabled allowing the selection of a distribution to use if an error occurs when distribution fitting is attempted at simulation start. Select **Suppress Warnings** to disable any warnings that an error occurred and the selected default distribution will be used.

11. **Stream** contains the random number stream (1 - 215) to use when drawing random samples from the **Fitted Distribution**.

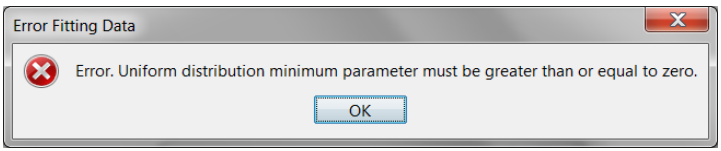
12. The **View Data** button reads the data sources and displays a list of the sample data along with summary statistics. The summary statistics include Number of Samples, Minimum, Maximum, Mean, Standard Deviation, Median, Skewness, and Coefficient of Variation.




Note that if the **Spreadsheet** data source **Starting Row** or **Column** or **Database** data source **SQL Query** are parameterized, the **View Data** button will not return data. A parameterized **Spreadsheet** or **Database** data source can only be read at the beginning of a simulation. **View Data** includes data validation so it can be used to verify the data before a distribution fit.

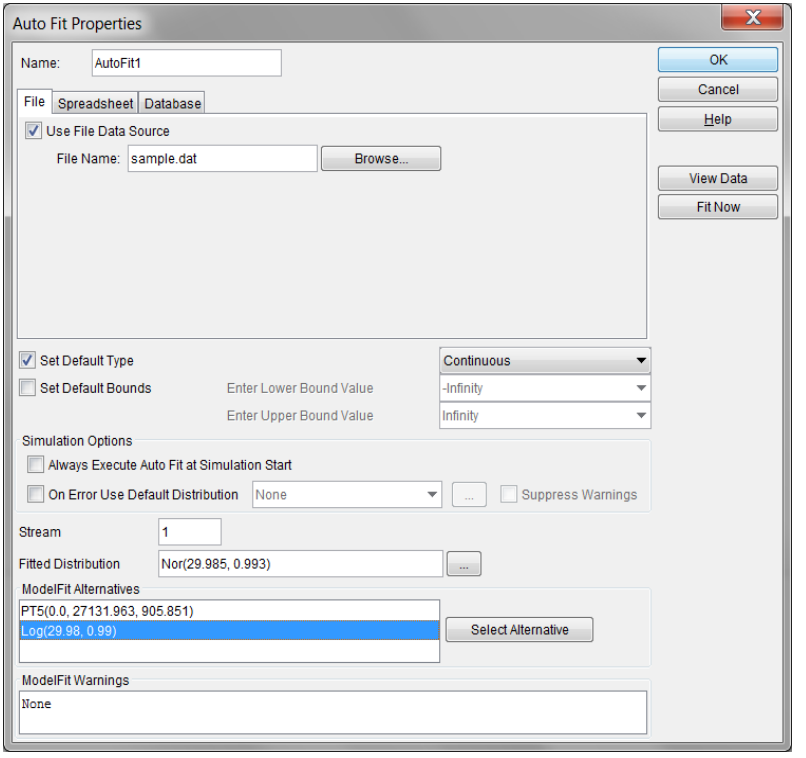

Error Reading Data
Error. Unable to perform requested operation. "Evl(Model.StartingRow)" can only be evaluated at the beginning of a simulation.
OK

**13.** The **Fit Now** button reads the data sources and calls ModelFit to perform the distribution fitting. If a good fit is obtained, the **Fitted Distribution** field displays the results. Note that **Fit Now** will not work if either the **Spreadsheet** or **Database** data sources are parameterized (see above). **Fit Now** includes data and distribution validation so it can be used to verify the data and distribution fit before a simulation run. The example error below shows that ModelFit created a Uniform distribution with a negative lower bound. A negative lower bound is not allowed. (See "Statistical Distributions" for information on distribution requirements.) Also, an error will occur if the **Fit Now** button is clicked and the Auto Fit license has not been activated.

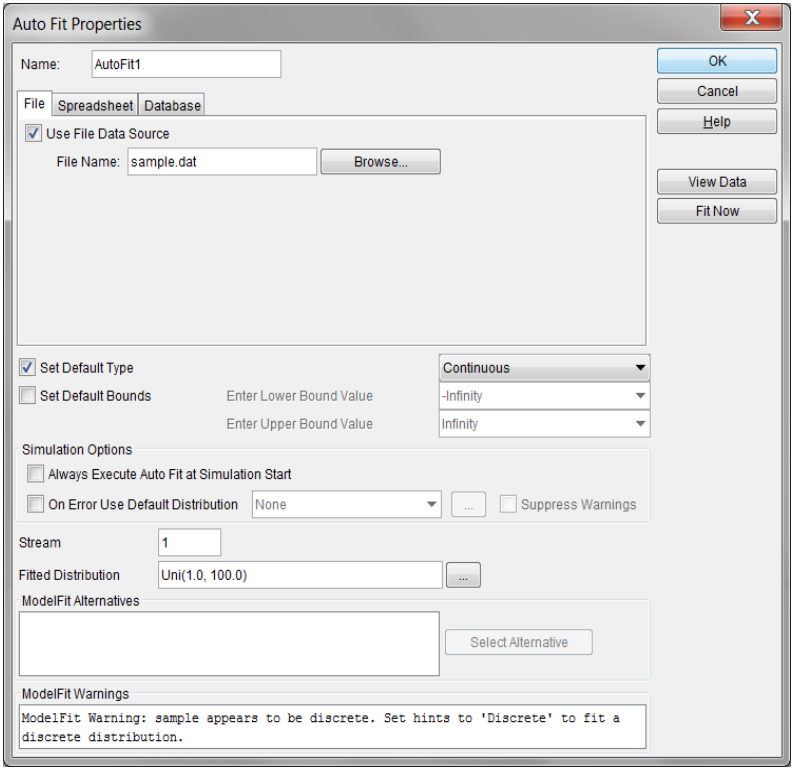



**14.** The **Fitted Distribution** field contains the results of an Auto Fit. The contents of the field can be selected and copied, but any changes to the field will not be saved. The details button to the right of the **Fitted Distribution** field can be used to view the individual parameters and view a plot of the distribution. Any changes made to the distribution parameters on the detail dialog will not be saved.

15. **ModelFit Alternatives** contains alternative distribution fits for the sample data. An empty list means that ModelFit determined that there were no acceptable alternatives. To use an alternative distribution, either select the distribution then click the **Select Alternative** button or double click the desired alternative. The primary distribution will be placed into the list of alternatives, and the selected alternative will be placed into the **Fitted Distribution** field. Note that **ModelFit Alternatives** are only applicable when using the **Fit Now** button. It is not possible to select an alternative when Auto Fit is run at simulation start. The primary distribution will always be used when Auto Fit is run at the beginning of a simulation. (When running Auto Fit at simulation start, alternatives generated by ModelFit are written to the `simprocess.log` file.) To use an alternative as the primary distribution, **Always Execute Auto Fit at Simulation Start** must not be selected.



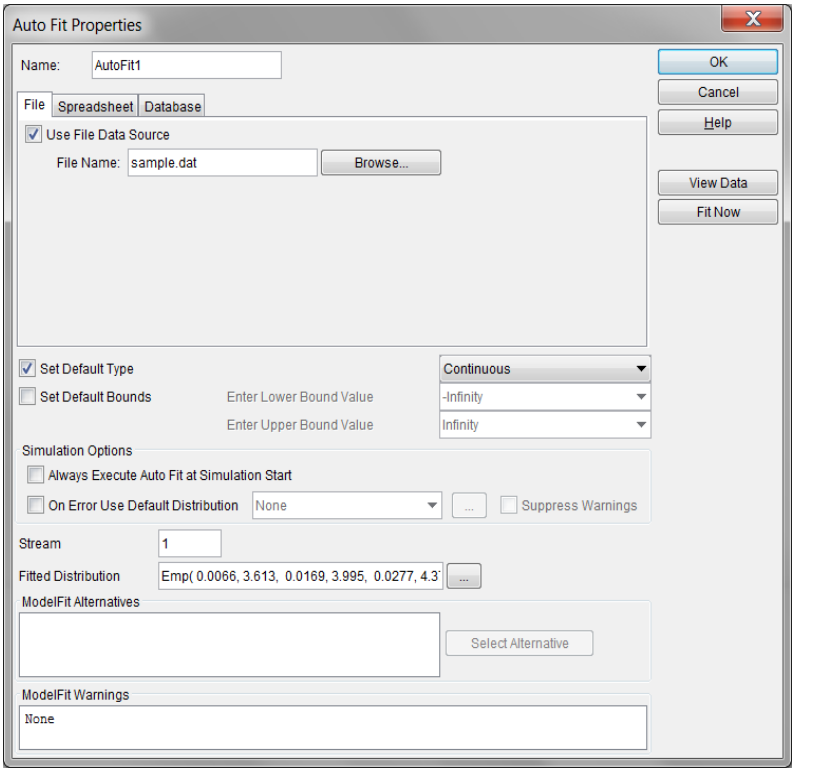

16. **ModelFit Warnings** contains warning messages from ModelFit concerning the **Fitted Distribution**. These warnings are only displayed here when the **Fit Now** button is used. The warnings are written to the `simprocess.log` file when fitting occurs at simulation start. (The `simprocess.log` and file is located in the SIMPROCESS working directory. See "SIMPROCESS Working Directory".) **None** is displayed if there are no warnings. The text of **ModelFit Warnings** can be selected and copied using the platform specific keyboard shortcuts.



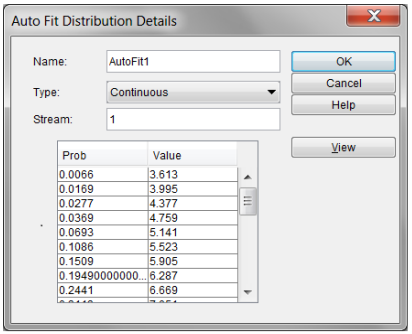

### *Empirical Distributions*

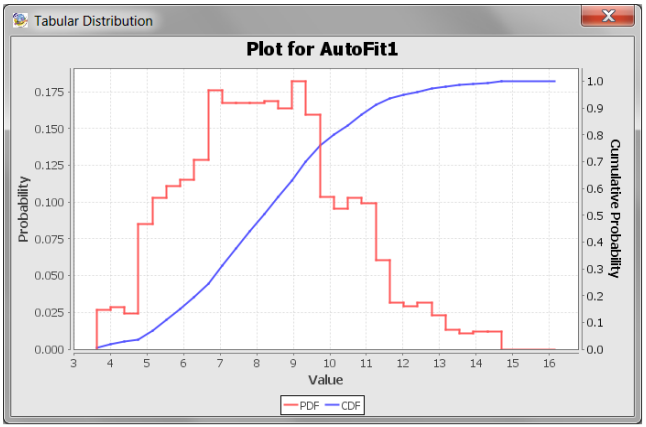
Sometimes ModelFit cannot fit the sample data to one of the SIMPROCESS distributions. This could be due to the sample data representing a distribution that SIMPROCESS does not support, an insufficient sample size, or both. When this happens, ModelFit returns an empirical distribution. The distribution defaults to **Continuous** unless **Discrete** is selected in **Set Default Type**.

An empirical distribution is a histogram based distribution and follows the format of the SIMPROCESS Tabular distribution (page 120). The distribution type displayed in the **Fitted Distribution** field will be `Emp` followed by pairs of cumulative probability and value. The pairs are just comma separated values. In the example below, the first two pairs of cumulative probability and value are (0.0060, 6.557) and (0.015, 7.715).



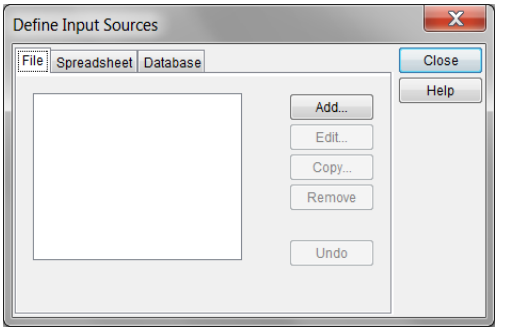

A table of the values can be displayed by selecting the details button next to the **Fitted Distribution** field. By selecting the **View** button, the dialog allows viewing a **Continuous** or **Discrete** (based on selected **Type**) plot of the empirical distribution. Note that changes to the **Name**, **Type**, or **Stream** are not saved.


Auto Fit Distribution Details
Name:
AutoFit1
Type:
Continuous
Stream:
1
OK
Cancel
Help
View
Prob
Value
0.0066
3.613
0.0169
3.995
0.0277
4.377
0.0369
4.759
0.0693
5.141
0.1086
5.523
0.1509
5.905
0.19490000000...
6.287
0.2441
6.669


Tabular Distribution
Plot for AutoFit1
Probability
Cumulative Probability
Value
PDF
CDF

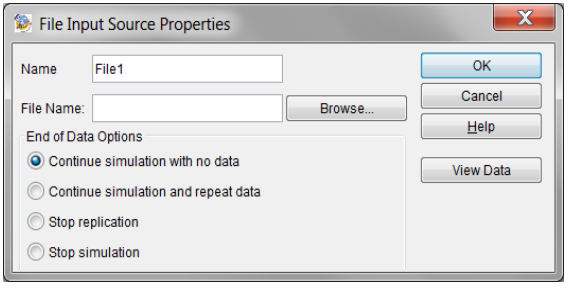
# Input Sources

**Input Sources** operate similarly to distributions in that they return a value. However, the value that is returned is retrieved from an external source. There are three types of external sources that can be used as **Input Sources**: **File**, **Spreadsheet**, and **Database**. Selecting **Input Sources...** on the **Define** menu displays the dialog for managing all three types of input sources.




## *File Input Source*

A **File** Input Source creates a connection to an ASCII file. The **File** tab is used for managing **File** connections. Use this tab to **Add, Edit, Copy**, or **Remove** a **File** Input Source. **Undo** retrieves one that has been removed. Selecting **Add**, **Edit**, or **Copy** brings up the dialog below.

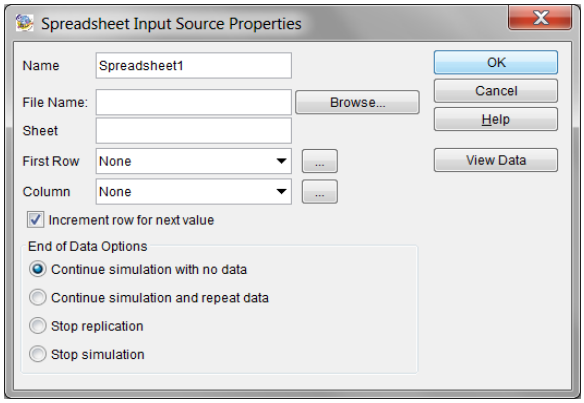



The default **Name** can be replaced, but the **Name** cannot contain special characters and must be unique across all Input Sources, Distributions, and Functions. Either type in the **File Name** or select **Browse** to choose the file. It is recommended that the input file be located in the model's directory. A Model Attribute of type STRING that contains the name of the file can be used in the **File Name** field. The values in the file should be separated by one or more white spaces (i.e., space, tab, or new line characters). Although not required, the file will usually contain a single value per line. The

input file can contain comments. Any characters that follow double slashes (**//**) will be ignored.

## *Spreadsheet Input Source*

A Spreadsheet Input Source creates a connection to an Excel compatible spreadsheet file. Two different file types are supported: Workbook files (which usually have the **.xls** or **.xlsx** extension) and Excel XML Spreadsheet files (which usually have the **.xml** extension). The **Spreadsheet** tab is used to manage **Spreadsheet** connections. Use this tab to **Add, Edit, Copy**, or **Remove** a **Spreadsheet** Input Source. **Undo** retrieves one that has been removed. Selecting **Add**, **Edit**, or **Copy** brings up the dialog below.



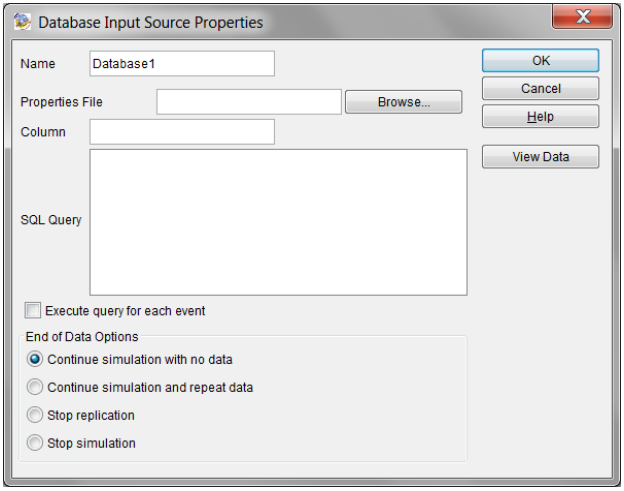

The default **Name** can be replaced, but the **Name** cannot contain special characters and must be unique across all Input Sources, Distributions, and Functions. Either type in the **File Name** or select **Browse** to choose the spreadsheet file. It is recommended that the input file be located in the model's directory. A Model Attribute of type STRING that contains the name of the file can be used in the **File Name** field. **Sheet** cannot be empty and should contain the name of the worksheet. As with **File Name**, a Model Attribute of type STRING that contains the name of the worksheet can be used in the **Sheet** field. **First Row** should contain the value of the first row that has input data. The evaluation of **First Row** must result in an INTEGER and must be greater than or equal to one. The evaluation of **Column** should also result in an INTEGER greater than or equal to one (column A in a spreadsheet is column 1). The default behavior is for the row value to be incremented every time a value is requested from the spreadsheet. (Data is read from the specified worksheet from top to bottom.) If the value in the cell represented by **First Row** and **Column** is to be returned every time a value is requested, then deselect **Increment row for next value**.

A run-time error will occur if the specified **Sheet** does not exist. Also, if the spreadsheet is a Workbook and a cell is read that contains a formula, the formula is evaluated and the value returned.

Note that not all spreadsheet formula functions are supported. A run-time error will occur if an attempt is made to read a cell that contains an unsupported formula. In an XML Spreadsheet, the value calculated by the formula will be returned if it already exists in the file; if not, a run-time error will result. Thus, in an XML Spreadsheet the formula is not evaluated at run-time.

## *Database Input Source*

A **Database** Input Source creates a connection between SIMPROCESS and a database. The **Database** tab is used to manage **Database** connections. Use this tab to **Add, Edit, Copy**, or **Remove** a **Database** Input Source. **Undo** retrieves one that has been removed. Selecting **Add**, **Edit**, or **Copy** brings up the dialog below.

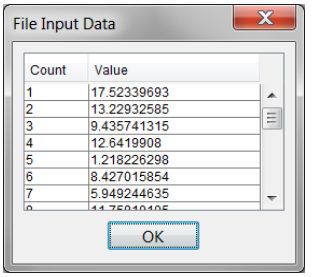



The default **Name** can be replaced, but the **Name** cannot contain special characters and must be unique across all Input Sources, Distributions, and Functions. **Properties File** must contain the database location/connection information. **Properties File** is the name of the properties file that contains the JDBC url and driver information and, if necessary, username and password. The **Properties File** must be located in the model's directory. (See "OpenDatabase" for more information on Properties Files.) The **Column** field must contain the name of a column returned by **SQL Query**, and **SQL Query** must contain the query that returns the input data. The **Properties File** and **Column** fields can contain a Model, Entity Type, or Entity Attribute of type STRING that contains the appropriate information. Also, the query can be parameterized by using Model, Entity Type, or Entity Attributes. For example, `"Select TIME_VALUE From TimeTable"` can be changed to `"Select Model.TableColumn From TimeTable"`. In this example, `Model.TableColumn` is a STRING Model Attribute that contains the name of the column to read. (Since the **Column** field can be parameterized, **Column** could also contain `Model.TableColumn`.) If **Execute query for each**

**event** is selected, **SQL Query** is executed every time a value is requested from the **Database** Input Source and the first value in the result set is returned. If **Execute query for each event** is not selected (default), then the next value in the result set is returned.

## View Data Button

All Input Source types have a **View Data** button. Once the appropriate fields have been populated this button will read the specified data source and display the input values. This option will not work if any of the fields can only be evaluated at run time. For example, if the Spreadsheet Input Source **Column** field is specified by an Attribute, View Data will not retrieve data from the spreadsheet.




## End of Data Options

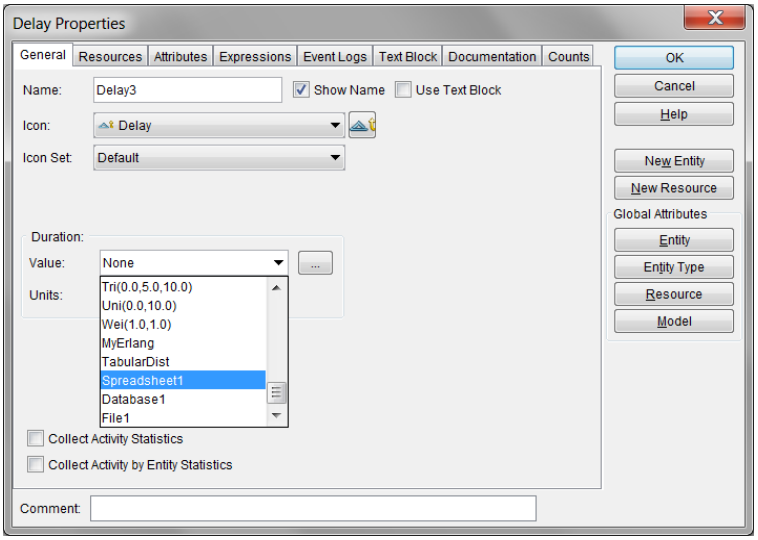
Each Input Source type has four options for what to do if the end of the data is reached before the end of the simulation is reached.

- **Continue simulation with no data**
- **Continue simulation and repeat data**
- **Stop replication**
- **Stop simulation**

The default option is **Continue simulation with no data**. When this option is selected and the data is numeric, a value of zero will be returned when the end of the data source is reached. If the data contains Strings, an empty string ("") will be returned. **Continue simulation and repeat data** causes the data in the Input Source to be repeated until the end of the simulation is reached. **Stop replication** stops the current replication but allows the next replication to continue. **Stop simulation** stops the current replication and all remaining replications will not execute. Both **Stop replication** and **Stop simulation** display a message when invoked. Note that Input Sources reset to the beginning of the data at the start of each replication if **Reset System** is selected in the Run Settings (page 137).

## Using Input Sources

Defined **Input Sources** appear in the SIMPROCESS distribution list. Thus, an Input Source can be used anywhere in the model where a statistical distribution is specified. In the example below, selecting the distribution list for the **Duration Value** of the Delay Activity shows that the distribution list contains one File Input Source (`File1`), one Spreadsheet Input Source (`Spreadsheet1`), and one Database Input Source (`Database1`).



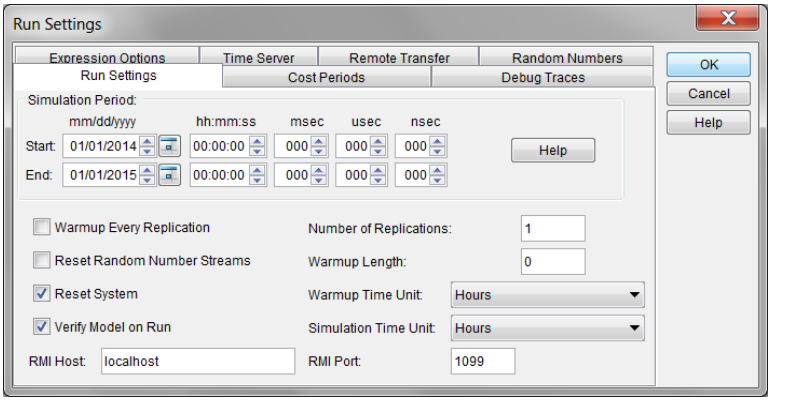

In the above example, the specified Input Source will return a delay value for each Entity that enters the Activity. Note that no error will occur if the next value is not a valid number, the end of the file is reached (File Input Source), there are no more rows with data (Spreadsheet Input Source), or there are no more values in the result set (Database Input Source). Zero is returned instead. Since Input Sources are part of the SIMPROCESS distribution list, they can also be used in Assign Activities (see "Assign Activity") to set user defined Attributes (see "User Defined Attributes"). In an Assign Activity, if the Attribute being assigned is of type STRING or BOOLEAN, then Input Sources can return a value that is not a number. If the Attribute is a STRING Attribute, then any value from the external source is converted to a STRING (if necessary) and assigned to the Attribute. If the Attribute is a BOOLEAN Attribute, then any value from the external source that is not the value `TRUE` will result in `FALSE` being assigned to the BOOLEAN Attribute. For a STRING Attribute an empty STRING ("") is assigned if there is an error with the external source or the end of the external source's data is reached. Likewise, for a BOOLEAN Attribute FALSE is assigned.

Input Sources can also be used with the Expression function `GetInputSourceValue`. When used in an Expression the returned value can be a REAL, BOOLEAN, or STRING. The only input parameter for `GetInputSourceValue` is the name of the Input Source. See "SIMPROCESS

System Methods" for a description.

A simple demonstration model that contains an example of each type of Input Source is in the Demos directory. The model bundle **`InputSource.bundle`** contains the model and supporting external sources. See "Extracting Bundle Files" for instructions on extracting a model bundle. Note that each Input Source in the example contains 24 data points. The model is set to run for one week so **Continue simulation and repeat data** was selected from the **End of Data Options**.

# Run Settings




## *Run Settings*

### *Simulation Period*

The **Simulation Period** determines how long the simulation will run. It is given in calendar and time format. Choose an appropriate time span to see all aspects of the system.

### *Warmup Every Replication*

When selected and the values for both the **Number of Replications** and **Warmup Length** are greater than 0, SIMPROCESS will start collecting statistics after the **Warmup Length** has expired for each replication.

### *Warmup Length*

If a **Warmup Length** is entered SIMPROCESS will start the collection of statistics for the model run, after the end of the **Warmup Length**. This gathers information on your system after it has reached "Steady State."

### *Warmup Time Unit*

The **Warmup Time Unit** specifies the time unit for the **Warmup Length**. It defaults to Hours.

### *Simulation Time Unit*

The **Simulation Time Unit** specifies the time unit for the simulation clock. It defaults to Hours.

### *Reset System*

Resets the system to the initial conditions before each replication.

### *Verify Model on Run*

Turns the automatic model verification on or off at the beginning of a simulation. The verification process checks for potential errors. (See "Verify Model" on page 66.)

### *Number of Replications*

When the model contains randomness (represented by statistical distributions) the model should be run for multiple replications. This averages the results and gives a more accurate picture of "most likely" outcome of the scenario being modeled.

Reports are gathered for each replication and the Sum and Average of all runs.

### *Reset Random Number Streams*

This option resets the **Random Number Stream** before starting each new replication. Typically, this should not be selected. In general terms, the reason for running the model for multiple replications is to test how randomness affects the system. Turning this option on negates that test.

### *RMI Host*

This indicates the host on which SPServer will be located if the model has an External schedule defined. Defaults to "localhost." (See "Adding an External Schedule".)

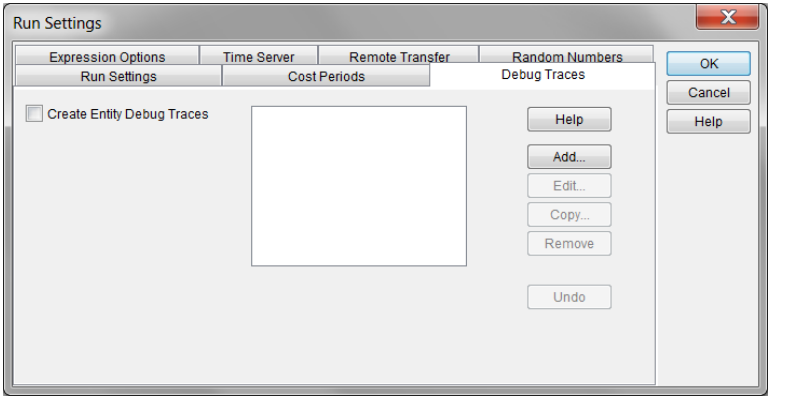
### *RMI Port*

This indicates the TCP port to use on the **RMI Host**. Defaults to 1099. (See "Adding an External Schedule".)

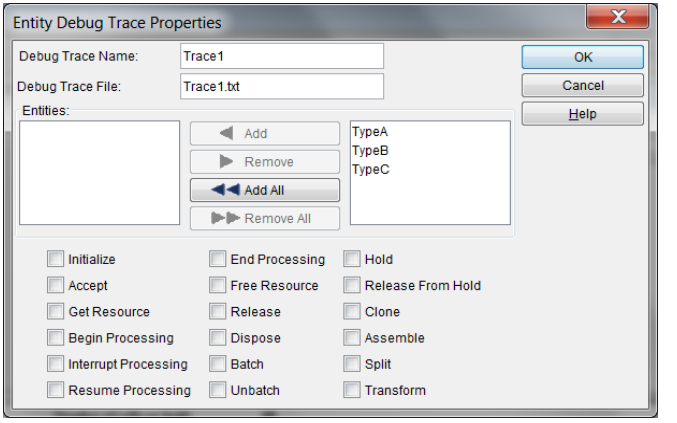
## *Cost Periods*

This tab sets the frequency over which the ABC Reports will be collected. The name of the currency that the ABC Reports will use can also be set. (See "Setting Up Cost Periods" on page 222.)

## *Debug Traces*




This tab turns on/off debug tracing and defines debug traces. If checked, **Create Entity Debug Traces** causes the creation of the debug traces defined in the box to the right. If no debug traces are defined, no debug traces are created during the simulation run. Click the **Add...** button to define a debug trace. This brings up a dialog for defining the debug trace.



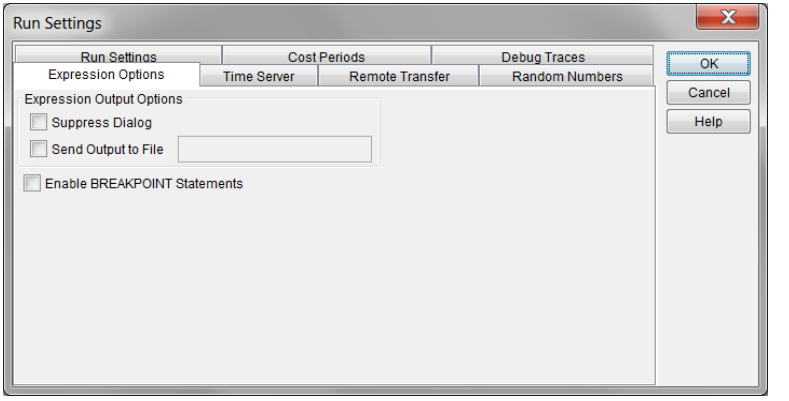

**Debug Trace Name** is the name of the trace that will appear in the list of traces. **Debug Trace File** is the name of the debug trace file to be created. If no path is included, the file will be created in the directory of the model. Select the **Entities** to be included in the trace. Entity types to be included should be moved from the list of entities on the left to the list of entities on the right. The checkboxes at the bottom are the Entity actions that can be included in the trace. Note that the **Clone**, **Assemble**, **Split**, and **Transform** actions apply to the Entity that initiates the action, not the Entity or Entities that result from the action.

Each debug trace file is a tab delimited file. The replication is added to the file (Replication 1,

Replication 2, etc.) and then a header line consisting of Action, Activity, Entity, SequenceNum, and SimTime. Each action added to the file consists of the action name (Initialize, Accept, etc.), the name of the activity, the name of the entity, the sequence number of the entity, and the simulation time.

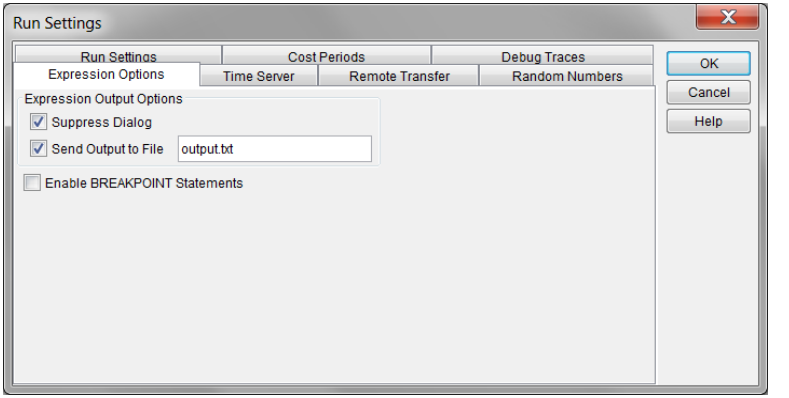
## Expression Options

The **Expression Options** tab contains options for two Expression statements: `OUTPUT` and `BREAKPOINT`. (See "Writing Expressions" for more information on Expressions.) The `OUTPUT` statement displays information in the SIMPROCESS Expression Output Dialog, and the BREAKPOINT statement pauses the simulation and displays simulation information. Both statements are especially useful for debugging.




### OUTPUT Statement

There are two options for `OUTPUT`: **Suppress Dialog** and **Send Output to File**. By default, both options are not selected. If selected, the **Suppress Dialog** option prohibits the SIMPROCESS Expression Output Dialog from displaying during a simulation. (Suppressing the dialog causes the simulation to run faster.) If **Send Output to File** is selected, the `OUTPUT` statements are written to the file entered in the adjoining text field. The file will be created in the model's directory, so it must not contain any path information and must be legal for the platform on which SIMPROCESS is running. (Note that these options also apply to the `ShowSystemAttributes` and `ShowUserAttributes` System Methods. See "SIMPROCESS System Methods".)




These options apply when running simulations using the Experiment Manager (see "Experiment Manager"). However, **Suppress Dialog** has no affect on the Experiment Manager Status Messages dialog.

SIMPROCESS models can be run without the SIMPROCESS Graphical User Interface (see "Running Models Without GUI"). The optimization tool OptQuest (see "OptQuest for SIMPROCESS") and the SIMPROCESS Dispatcher do this. (The SIMPROCESS Dispatcher is an optional feature that allows SIMPROCESS to be used with a Web service. If the SIMPROCESS Dispatcher was installed, see `SIMPROCESS Dispatcher.pdf` in the `dispatcher` directory for more information.) If **Suppress Dialog** and **Send Output to File** are not selected, then `OUTPUT` statements are written to the appropriate log file. In most cases, the log file will be `simprocess.log`. When using OptQuest, the log file is `optQuest.log`. (The `.log` files are located in the SIMPROCESS working directory. See "SIMPROCESS Working Directory".) The Dispatcher log file is `Dispatcher.log`. Its location is dependent on where the Web service is located. If either **Suppress Dialog** or **Send Output to File** is selected, then no information is sent to a log file. When **Send Output to File** is selected, the `OUTPUT` statements are written to the designated file.

Whether running a model with or without the SIMPROCESS GUI, the file designated in **Send Output to File** will contain output for all replications; however, when the same model is run again, the file will be overwritten. So if a user, the Experiment Manager, OptQuest, or the SIMPROCESS Dispatcher runs the same model multiple times, the file will only contain information from the last run.

### *BREAKPOINT Statement*

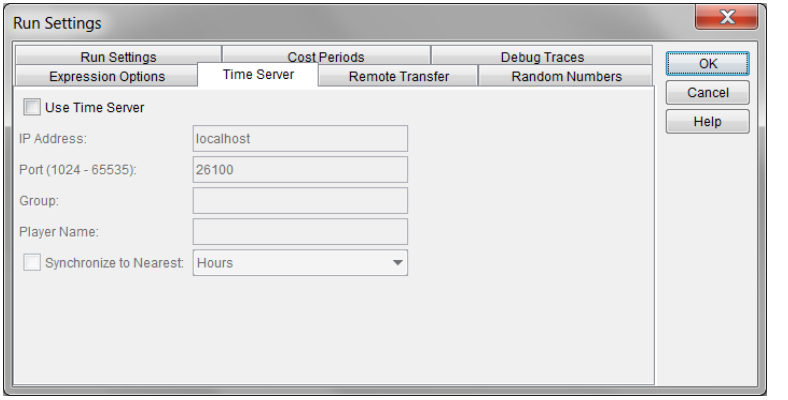
`BREAKPOINT` statements cause the simulation to pause. While paused the BREAKPOINT Analyzer can be used to determine the status of simulation components. **Enable BREAKPOINT Statements** must be selected for `BREAKPOINT` statements to be active. Note that `BREAKPOINT` statements are always inactive when running without the SIMPROCESS Graphical User Interface. (See "Method BREAKPOINT" for more information on BREAKPOINT.)

## Time Server

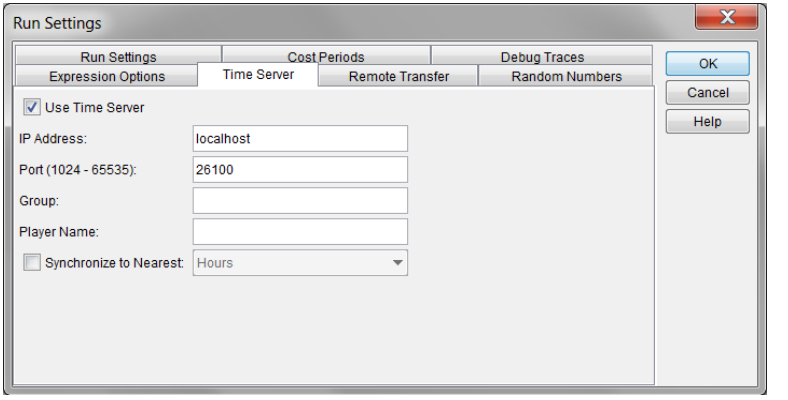
SIMPROCESS models have the ability to let an outside agent manage the advancement of simulation time. The TimeServer is a separate application which can manage simulation time for multiple participants. It can be run on the same machine as SIMPROCESS or on another system. See `SIMPROCESS TimeServer.pdf` in the `timeserver` directory for more information, including how to configure and run the TimeServer application. The `timeserver` directory is in the SIMPROCESS working directory.

The TimeServer supports one or more groups of players. Each group has a unique name among those handled by a single instance of the TimeServer, and each group manages its own time independently of all other groups. Thus, for a SIMPROCESS model to use the TimeServer, it must join a predefined TimeServer group as a player.

### Time Server Settings




The **Use Time Server** option is initially not selected. When selected, **IP Address**, **Port**, **Group**, **Player Name**, and **Synchronize to Nearest** become enabled. Values for **IP Address**, **Port**, **Group**, and **Player Name** are required when using the TimeServer while **Synchronize to Nearest** is optional.



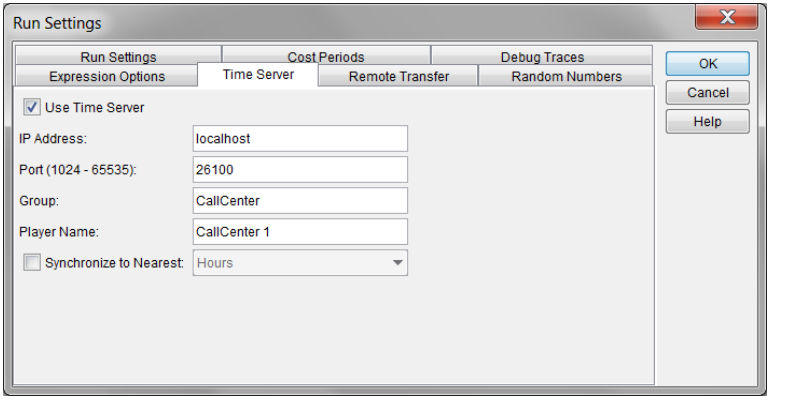

**IP Address** defaults to `localhost`, which indicates that the TimeServer will be running on the same system as SIMPROCESS. If the TimeServer will be running on a different system, then the IP address or host name of that system should be entered.

**Port** can be between 1024 and 65535 inclusive and defaults to 26100.

**Group** is the name of the TimeServer group that this model will join. Groups are defined as part of the TimeServer configuration. See `SIMPROCESS TimeServer.pdf` in the `timeserver` directory for more information.

**Player Name** is the name by which the simulation will be known to the TimeServer **Group**. This name cannot be duplicated within a **Group**.

In the example below, at the start of the simulation, the model will join the group `CallCenter` as `CallCenter 1`.



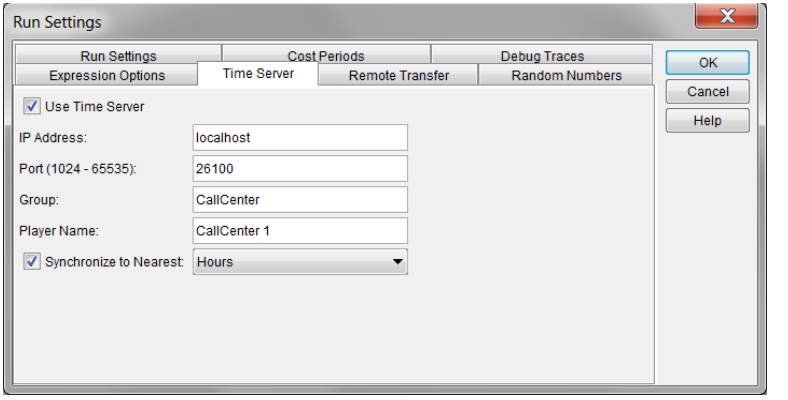

During simulation SIMPROCESS creates events internally, each bearing a time stamp indicating the

simulation time when they will be processed. Events are placed into a queue to be processed in the order of their simulation times. A large and complex model will handle a great many such events as it simulates.

When a TimeServer is used to manage simulation time externally, an additional step is introduced into this process. Before any event can be processed, SIMPROCESS must have gained approval from the TimeServer to advance to or beyond that event's time. Therefore, SIMPROCESS must recognize when it has events scheduled to occur later than the most recently approved time and send a request for time advancement to the TimeServer.

When **Synchronize to Nearest** is not selected, this event handling occurs naturally, as dictated by the simulation times of each event and the responses from the TimeServer. This is referred to as *full synchronization*. Events may occur with very small amounts of time between them. Large and complex models can send a significant number of time advancement requests to the TimeServer. Depending on the number of players participating in the simulation group, and the complexity of their respective simulations, this can result in a great deal of time spent simply waiting for time advancement approval and can therefore cause overall simulation performance to suffer.

Selecting **Synchronize to Nearest** can sometimes improve this situation. When selected, it enables the list for selecting an available time unit, which defaults to Hours. (All valid SIMPROCESS time units are available.) When used, SIMPROCESS will round all its requests for time advancement to integer numbers in the selected time unit (this time unit need not match the **Simulation Time Unit**, discussed on page 137, though it should usually not be a smaller unit). This is referred to as *rounded synchronization*.




As an example, assume that the current simulation time is 1.0 Hours and that the next event in the simulation is scheduled to occur at 1.25 Hours. Instead of sending a request for time advancement to 1.25 Hours, a request for 2.0 Hours will be sent. This is because 2 is the smallest integer value greater than 1.25. If the TimeServer approves the request by sending a time advance notification of 2.0 Hours back to the SIMPROCESS model, then simulation events with times less than or equal to 2.0 Hours

will not require sending new time advance requests. So if the next three events had times of 1.5, 1.75, and 2.0 Hours, respectively, those events would not cause new time advance requests to be sent to the TimeServer, thus potentially improving performance by reducing the overall number of requests sent to the TimeServer and enabling SIMPROCESS to continue processing events without delay. (If a shorter time were approved instead, SIMPROCESS would process its events up to the newly approved time and submit another rounded time advance request.)

Note that the effectiveness of rounded synchronization will depend in part on the strategies employed by the other players in the group. If the other players are using full synchronization, or are using rounded synchronization with a smaller time unit, there may little or no benefit.

### *Time Server Errors*

Various errors can cause the premature end of the initialization or run of a simulation that is using the TimeServer.

- TimeServer is not running
- TimeServer stops
- Invalid Group
- Group is already full (all players have joined)
- Group is reinitialized
- Duplicate player name
- Communication error
- Another player terminates with an error condition (there is an option to continue in this case)

### *Time Server Considerations*

When another player completes normally before the completion of the SIMPROCESS simulation, the simulation will continue until it is finished. However, if another player terminates for a different reason, SIMPROCESS will ask whether to continue or stop the simulation.

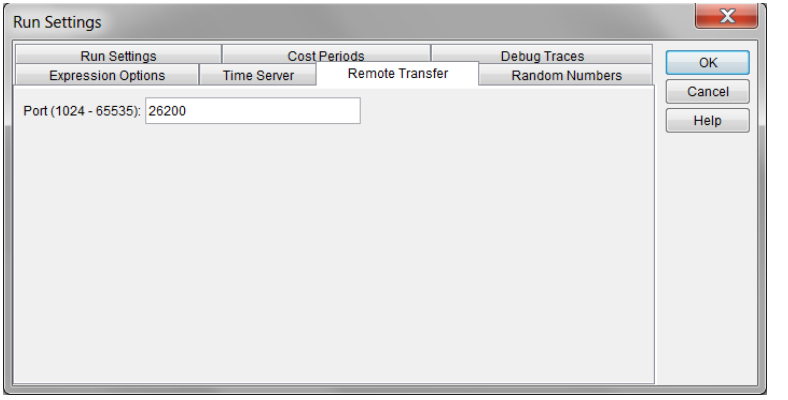
A SIMPROCESS model should not use External schedules along with a TimeServer. This can lead to unpredictable results. See "Adding an External Schedule" for more information on External schedules.

It is not strictly necessary for all SIMPROCESS players to use the same **Number of Replications** or to have the same setting for **Reset System** (both discussed on page 138). However, it's strongly suggested that all SIMPROCESS players in a group use the same **Number of Replications** and **Reset System** settings.

## *Remote Transfer*

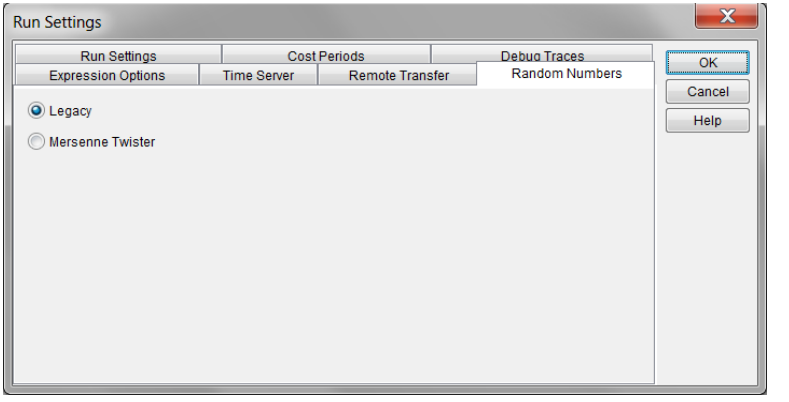
The Transfer Activity can transfer Entities between two different layouts within the same model or

between two or more different models. The latter scenario is a Remote Transfer. (See "Transfer Activity," beginning on page 166 for more information on the Transfer Activity.) The **Remote Transfer** tab specifies the communication port to use if the model contains Transfer Activities that are receiving Entities from another model. It defaults to `26200`.




## *Random Numbers*

Sets the type of random number generation to use for the simulation. (See "Random Number Generation" on page 116.)



CHAPTER 4

# *Activity Modeling Constructs*

The SIMPROCESS Activities that were not covered in Chapter 2, "SIMPROCESS Basics," beginning on page 73, can be divided into two categories: Entity Related and Resource Related.

## *Entity Related*

These Activities coordinate groups of Entities and includes:

- *Assemble*. Receives two or more Entities and assembles them into a single Entity that is released.
- *Branch*. Routes Entities through different Connectors of the model network.
- *Merge*. Routes Entities from different Connectors onto one Connector.
- *Batch*. Stores Entities until conditions set by the user are met, and then releases the Entities in one batch. The Entities emerge as a single unit, but retain their individual Entity identification.
- *Unbatch*. Separates a batched Entity into its constituent parts (Entities).
- *Split*. Divides an Entity into parent and child Entities that can undergo parallel processing.
- *Join*. Reunites families of Entities that were created in Split Activities
- *Transform*. Transforms an arriving Entity into a different Entity type, and releases one or more Entities of the new type.
- *Transfer*. Routes an entity from one model layout to another model layout without using a connector, or routes an entity from one model to another.

- *Clone*. Makes duplicate copies of Entities.
- *Gate*. Accumulates Entities until a condition is met and then releases a specified number of them.
- *Assign*. Assigns values to global Entity and Model Attributes and sets Entity priorities.
- *Synchronize*. Coordinates the release of various Entities.

### Resource Related

Unlike other SIMPROCESS Activities, these Activities affect Resources, not Entities:

- *Replenish Resource*. Adds capacity to consumable Resources.
- *Get Resource*. Obtains a Resource and holds on to it across several Processes and Activities.
- *Free Resource*. Releases Resources obtained by Get Resource Activities.

Resource-related Activities are described in Chapter 5, "Resource Modeling Constructs," beginning on page 181. The Entity-Related Activities are covered in this chapter.

# Entity-Related Activities

Activities that are used to coordinate grouping of Entities are addressed here. The type of coordination to be done is specified at the Activity. Entities are queued up in these Activities (except for Unbatch and Split) until the conditions are met. This queueing time is reported as "Hold for Condition" in the reports. This is reported separately from the "Wait for Resource" queueing time which can accumulate at any Activity for which a Resource requirement has been specified.

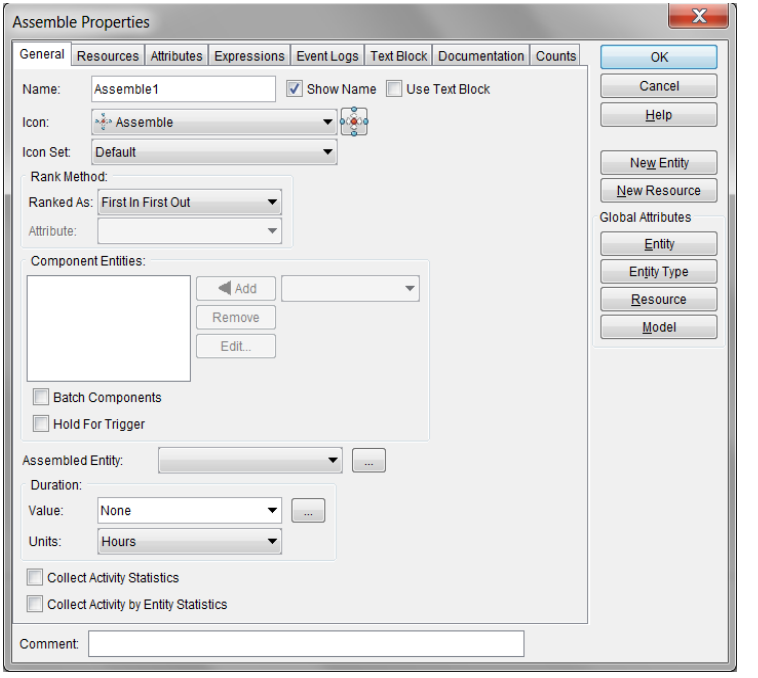
- Assemble Activity
- Batch Activity
- Unbatch Activity
- Gate Activity
- Synchronize Activity
- Split Activity
- Join Activity

## *Assemble Activity*

The Assemble Activity is used to build several Entities into a single output Entity. Consider a case where two approvals and a check are required to form one "approved loan." An Assemble Activity can be used to model this process.

Assemble has two input Pads (*Component* and *Trigger*) and two output Pads (*Out* and *NoMatch)* that determine Entity behavior. The Component Pad places incoming Entities into a queue until all Entities to be assembled have arrived. An Entity entering the Component Pad not on the component Entity list will immediately leave the Assemble Activity through the NoMatch Pad.

The Trigger Pad is only relevant if **Hold for Trigger** is selected as one of the Activity's options. Entities entering the Trigger Pad can trigger the release of the assembled Entities. Assembled Entities are only released when an Entity, such as a Customer Order, arrives at the Trigger Pad. The trigger can be released by using the `FireTrigger` System Method instead of having an Entity enter the Trigger Pad. The name of the Activity must be unique within the model for the system method to work properly. See "SIMPROCESS System Methods".




### *Dialog Field Definitions*

**Rank Method** sets the rank method of the queue for the Entities to be assembled. There is a separate queue for each component Entity type. The rank method is the same for all queues. The default is **First In First Out**. The rank methods are:

- **First In First Out**
- **First In Last Out**
- **Earliest Created First**
- **Latest Created First**
- **Highest Priority Value First**
- **Lowest Priority Value First**
- **Highest Attribute Value First**
- **Lowest Attribute Value First**

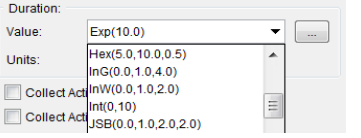
Selecting **Highest Attribute Value First** or **Lowest Attribute Value First** will cause the **Attribute** field to be active. Select the desired attribute from the list. If the selected attribute is a local Entity instance or Entity type attribute, a run time error will occur if an Entity enters that does not have the selected attribute defined.

**Component Entities** is a list of component Entities to be converted to assembled Entities. Entities on the list are queued until the specified quantity of each Entity type has entered the Assemble Activity.

- **Add:** Opens a dialog to define component Entities
- **Edit:** Opens a dialog to modify the component Entity definition
- **Remove:** Removes the selected component Entity
- **Batch Components:** When selected, the assembled Entity batches the component Entities. When not selected, component Entities are disposed when the assembled Entity is released.
- **Hold for Trigger:** Holds output Entities until an Entity enters the Trigger Pad.

**Assembled Entity** shows the Entity type to be released after all component Entities have entered the Activity. A combo box provides a list of defined Entity types.

**Duration** specifies the delay time of the Activity. The time set in the **Duration** will be applied after the Assembled Entity has been created. Thus, the **Duration** will be reflected in the Cycle Time of the Assembled Entity.

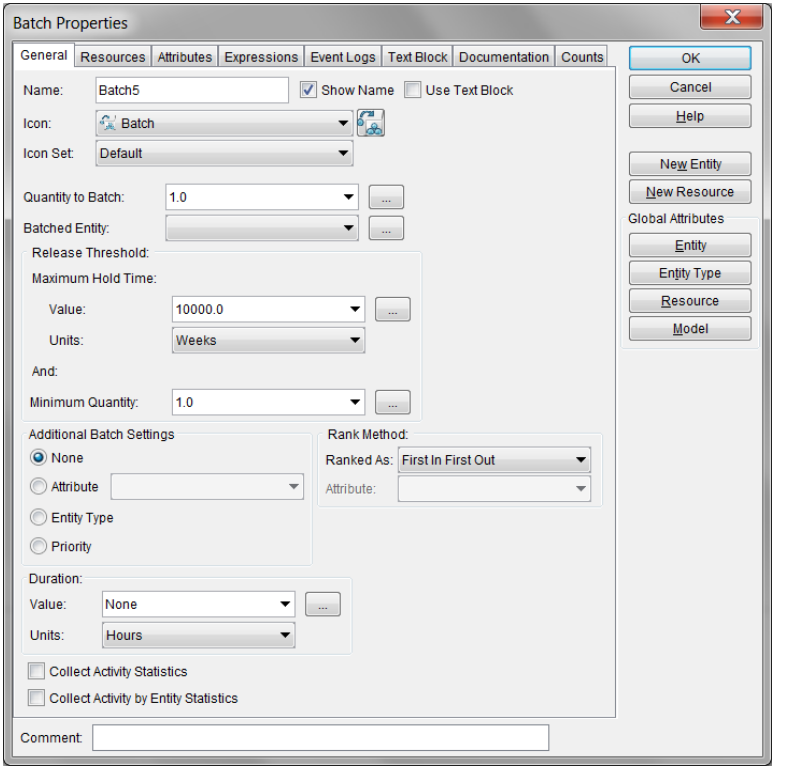



- **Value:** The amount of time required to perform this Activity. Use the combo box to select a statistical distribution or enter a constant value directly in this field.
- **Units:** Determines if the **Duration** entered is measured as nanoseconds, microseconds, milliseconds, seconds, minutes, hours, days, weeks, months, or years.

## *Batch Activity*

The Batch Activity combines several Entities into one Entity while retaining the identities of the original Entities. The resultant Batched Entity travels throughout the process as a single Entity. It can be disassembled into its constituent Entities using an Unbatch Activity at some later time.

The Batch Activity is useful when combining several Entities (e.g., merchandise ordered by various customers) into a parent Entity for transportation. After the transportation Activities, the parent Entity can be broken down into the Entities that comprised it. Statistics can be collected for the batched Entity separately from its constituent members.




### *Dialog Field Definitions*

**Quantity to Batch** is the maximum number of Entities that fit in one batch.

**Batched Entity** is the type of Entity that will serve as the container or *parent* Entity. An Entity of this type is created and all other Entities become children of the parent.

**Maximum Hold Time:** is the maximum amount of time to hold before a batch that has met the **Minimum Quantity** requirement is released.

**Minimum Quantity** is the minimum number of Entities that must be in a batch before it can be released.

**Additional Batch Settings** determines if additional information should be used in creating batches. The options are

- **None** (default)
- **Attribute**
- **Entity Type**

- **Priority**

If an option other than **None** is selected, batches will be created based on common values for the selected option. For example, if **Entity Type** is selected, all Entities of the same type waiting in the Batch Activity will be batched together. Thus, if more than one type of Entity is in the Batch Activity, more than one Batched Entity will be created (one for each type of Entity in the Batch Activity). Each batch will only contain Entities of the same type. When **Attribute** is selected, the User Defined or System Attribute to group by must be selected from the adjoining list. (See "Using Attributes in SIMPROCESS" for more information on User Defined and System Attributes.) Since the value of the selected Attribute will be the same for all Entities in the batch, if the selected Attribute is an Entity User Defined Attribute, the same Attribute of the Batched Entity will be set to value of the Attribute of the child Entities. For example, if `Entity.Attribute1` is 10 for the Entities in the batch, then `Entity.Attribute1` will be set to 10 for the Batched Entity. The same holds true when **Priority** is selected. The priority of the Batched Entity will be the same as the priority of the Entities in the batch.

**Rank Method** sets the rank method of the queue for the Entities to be batched. The default is **First In First Out**. The rank methods are:

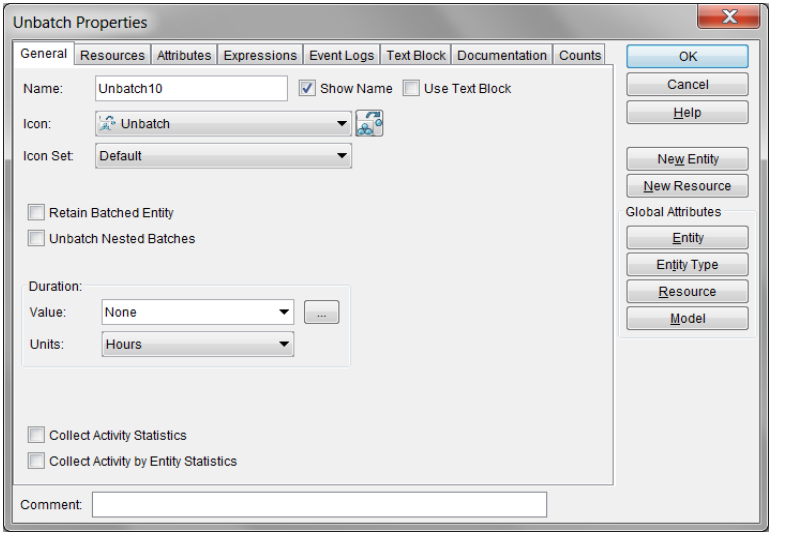
- **First In First Out**
- **First In Last Out**
- **Earliest Created First**
- **Latest Created First**
- **Highest Priority Value First**
- **Lowest Priority Value First**
- **Highest Attribute Value First**
- **Lowest Attribute Value First.**

The **Attribute** field will be active if **Highest Attribute Value First** or **Lowest Attribute Value First** is selected. Select the desired attribute from the list. If the selected attribute is a local Entity instance or Entity type attribute, a run time error will occur if an Entity enters that does not have the selected attribute defined.

**Duration** is the time specified for a Batch Activity that will be applied after the Batched Entity has been created. It will be reflected in the Cycle Time of the Batched Entity.

## *Unbatch Activity*

An Unbatch Activity separates a batch Entity into its constituents (children) and then by default destroys (*Disposes*) the parent Entity. Many levels of batching are possible, i.e., batches can be composed of batches. The Unbatch Activity defaults to only disaggregate one level of batch at a time. **Unbatch Nested Batches** must be selected to disaggregate all levels.




The time specified in the **Duration** will be applied before the unbatching occurs. It will be reflected in the Cycle Time of the Batched Entity.

The Unbatch Activity defaults to disposing the Batched Entity that enters the Activity. **Retain Batched Entity** must be selected for the Batched Entity to not be disposed. The Batched Entity will continue through the simulation with no child Entities.

## *Gate Activity*

The Gate Activity accumulates Entities until some number of Entities have been received or until a signal is received to release Entities. It then sends a designated number of Entities out into the model. Entities can be batched in a Gate Activity.

A Gate Activity has two Pads that determine Entity behavior, the *Hold* Pad and the *Trigger* Pad. The Hold Pad, located on the lower left of the Gate icon, is a queue for incoming Entities. Entities that arrive at that Pad are stored here. The Trigger Pad, located on the upper left of the Gate icon, signals release of Entities.

A Gate Activity has two gating policies that can be effective concurrently. The first gating policy is **Threshold Release**. It allows the release of some number of Entities once a threshold number of Entities have arrived. This policy is useful, for example, in cases where a truck must wait until it is full before it departs.

The second gating policy is **Trigger Release**. An Entity is disposed of when it arrives at a Trigger Pad,

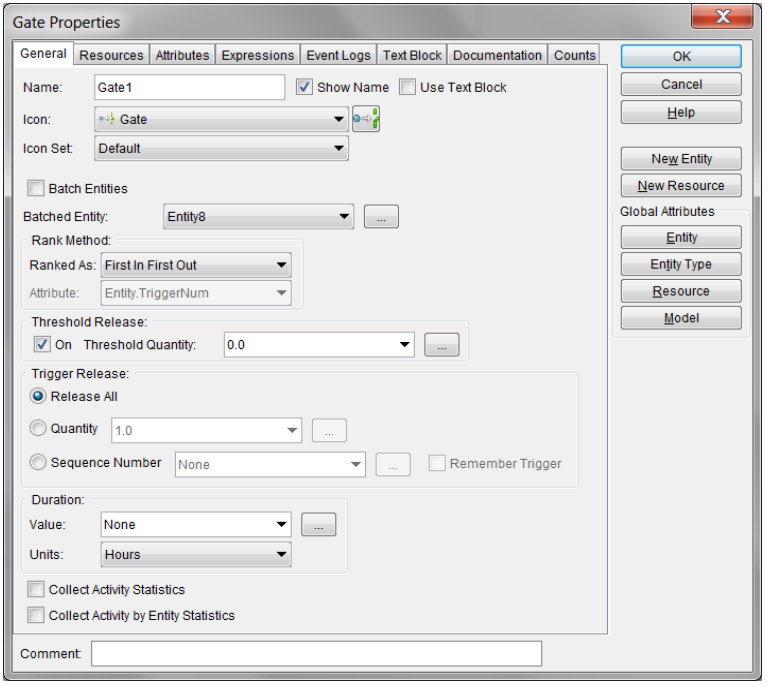
and it triggers the release of Entities based on the selection of **Release All**, **Quantity**, or **Sequence Number**. A Trigger Pad can synchronize the flow of Entities between different Activities.

The Gate Activity can be used as a buffer or queue to hold material from one section of the model until a condition is met in another part of the model. A Trigger Entity is sent to the Trigger Pad of the Gate Activity when that condition is met.

An example of this would be if customer orders are printed out and sent on to the shipping department on an hourly basis. This could be reflected in the model by a Gate Activity, which is triggered when it receives an Entity that is generated hourly by a Generate Activity.

Gating policies can be effective concurrently, so this Activity can implement a truck leaving when it is full or on the hour, even if it is not full.

Note that Entities can be released from Gate Activities using Expressions. See "Customizing a Model with Attributes and Expressions" for information on Expressions. Also, see "Methods ReleaseEntity, Gate, GetEntity, EntityExists".




### *Dialog Field Definitions*

**Batch Entities** will batch the Entities before leaving the Activity.

**Batched Entity** is the type of Entity that will serve as the container or *parent* Entity. An Entity of this type is created, and all other Entities become children of the parent.

**Rank Method** sets the rank method of the queue for the Entities waiting at the Gate. The default is **First In First Out**. The rank methods are

- **First In First Out**
- **First In Last Out**
- **Earliest Created First**
- **Latest Created First**
- **Highest Priority Value First**
- **Lowest Priority Value First**
- **Highest Attribute Value First**
- **Lowest Attribute Value First**

The **Attribute** field will be active if **Highest Attribute Value First** or **Lowest Attribute Value First** is selected. Select the desired attribute from the list. If the selected attribute is a local Entity instance or Entity type attribute, a run-time error will occur if an Entity enters that does not have the selected attribute defined.

#### Threshold Release

- **On/Off**: Enables/disables the **Threshold Release** feature. **Threshold Release** is on when the check box is selected.
- **Threshold Quantity**: The threshold number of Entities to accumulate and release when the **Threshold Release** is checked on.

#### Trigger Release

- **Release All**: Releases all the accumulated Entities when a Trigger Entity has been received on the Trigger Pad.
- **Quantity**: The number of Entities to release when a Trigger Entity has been received on the Trigger Pad. This is used with the **Trigger Release** policy. The value can be a constant integer or can be derived from a statistical distribution.
- **Sequence Number**: Attempts to release a specific Entity. The Entity to release is based on the Entity Sequence Number, which is a unique integer number that is given to every Entity instance that is created. (It can be referenced by the Entity System Attribute `SequenceNum`. See "System Attributes" in Appendix F of the *SIMPROCESS User's Manual*.) The sequence number of the Entity to be released is specified in the distribution list. Typically, the sequence number will be stored in an Entity Instance Attribute of the Entity that enters the trigger pad. Thus, the distribution would be something like `Evl(Entity.SomeAttribute)` where `SomeAttribute` is an Entity Instance Attribute of type INTEGER. (See "User Defined Attributes" in Chapter 2 of Part B of the *SIMPROCESS User's Manual* for more information

on using Attributes.) The sequence number must be greater than or equal to 1. There is also the **Remember Trigger** option. Normally, the Gate Activity does not remember that an Entity has entered the trigger pad. For example, assume **Release All** is specified for **Trigger Release**. If an Entity enters the trigger pad and no Entities are holding in the Gate, that trigger simply does nothing. When the next Entity arrives to be held at the Gate it will remain in the Gate even though an Entity previously entered the trigger pad and no Entities were released. However, given that **Sequence Number** seeks to release a specific Entity based on the sequence number, if **Remember Trigger** is selected, when an Entity enters the trigger pad and the specific Entity is not holding at the Gate Activity, the Gate Activity will keep track of the requested sequence number. So if the Entity with the requested sequence number enters after the trigger Entity it will continue on without holding at the Gate. If **Remember Trigger** is not selected and the requested Entity is not holding at the Gate, that trigger does nothing. When the requested Entity subsequently enters the Gate, it will remain in the Gate. Note that at this point the only way to get the Entity to release is by having another Entity enter the trigger pad requesting that sequence number or **Threshold Release** is selected and the **Threshold Quantity** is met. Specific Entities can also be released from a Gate by using the `ReleaseEntity` System Method. (See "Methods ReleaseEntity, Gate, GetEntity, EntityExists" in Appendix F of the SIMPROCESS User's Manual for more information.)

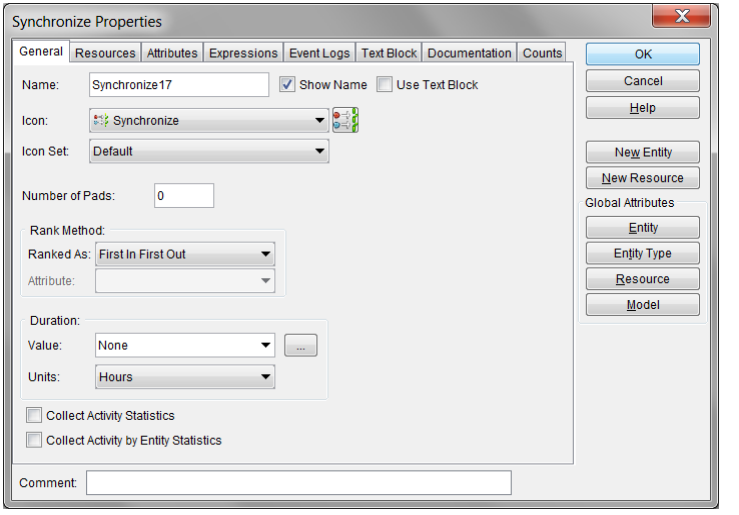
The Trigger can be released by using the `FireTrigger` System Method instead of having an Entity enter the trigger Pad. The name of the Activity must be unique within the model for the system method to work properly. Also, a run time error will occur if **Sequence Number** is selected for **Trigger Release** and the distribution references an Entity Instance or Entity Type Attribute. See"SIMPROCESS System Methods".

**Duration** is the time specified for a Gate Activity that will be applied when the Entities are released. Each Entity released will have a duration, unless the Entities were batched. In that case there is only one duration for the Batched Entity.

## *Synchronize Activity*

A Synchronize Activity coordinates the release of many Entities, which may be of various types. The number of input/output Pads for a Synchronize Activity is specified. Entities arriving at each Pad are stored in separate queues. Each queue releases one Entity to its corresponding output Pad when each queue has at least one Entity.

A project may require four jobs to be done in parallel, with the work kept in step at various tasks within the process. All others must be at the same stage of completion before work can proceed on one job. Synchronize Activity may be used with four Pads to model the wait time and release of the parallel tasks.




### *Dialog Field Definitions*

**Number of Pads** is the number of pairs of input and output Pads required by this Activity.

**Rank Method** sets the rank method of the queues for each input Pad. Each queue will have the same rank method. The default is **First In First Out**. The rank methods are:

- **First In First Out**
- **First In Last Out**
- **Earliest Created First**
- **Latest Created First**
- **Highest Priority Value First**
- **Lowest Priority Value First**
- **Highest Attribute Value First**
- **Lowest Attribute Value First**

The **Attribute** field will be active if **Highest Attribute Value First** or **Lowest Attribute Value First** is selected. Select the desired attribute from the list. If the selected attribute is a local Entity instance or Entity Type attribute, a run time error will occur if an Entity enters that does not have the selected attribute defined. **Duration** is the time specified for a Synchronize Activity that will be applied to each Entity when the Entities are released.

# Entity Control Activities

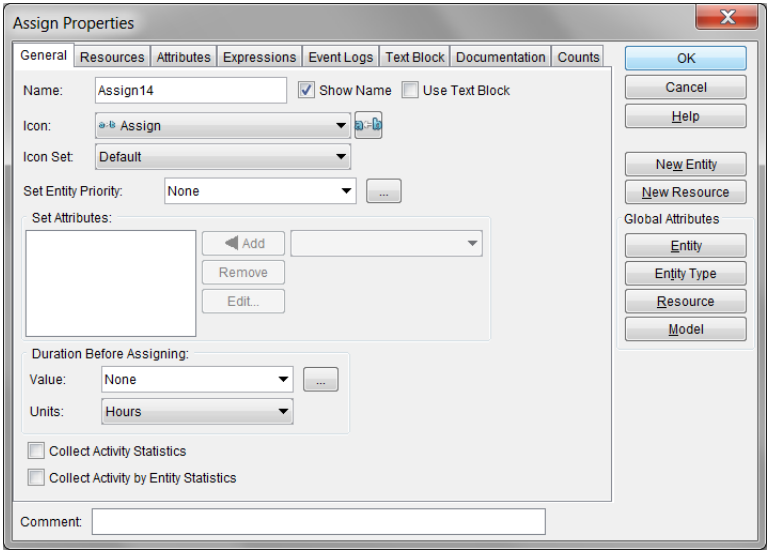
This section discusses Activities that are used in the control of Entities through the process model:

- Assign Activity
- Transform Activity
- Branch Activity
- Merge Activity
- Transfer Activity
- Clone Activity

## *Assign Activity*

The Assign Activity is one method used to assign values to attributes. The Assign Activity can also be used to change the priority of an Entity.

The Assign Activity is covered in detail in "Assign Activity".




### *Dialog Field Definitions and Buttons*

**Set Entity Priority** sets or changes the Priority of an Entity. The priority defaults to **None**, which means

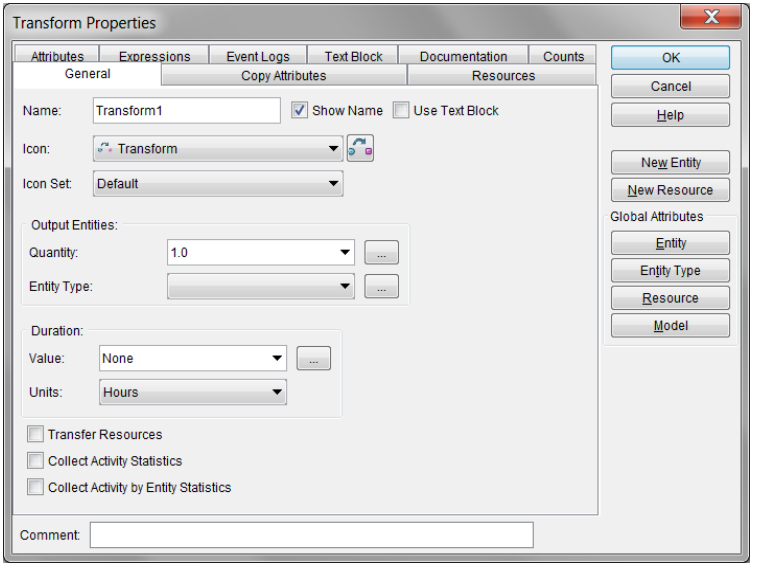
the Entity priority is not changed. Entity priority must be within the range 1 to 100. If a value less than 1 is returned from the distribution, then the Entity priority is not changed. If a value greater than 100 is returned from the distribution, then a warning is displayed, and the Entity priority is set to 100. **NOTE:** Entities with a higher priority use available Resources first. **Duration** is used as in other SIMPROCESS Activities.

**Set Attributes** lists existing attribute assignments:

- Use **Add...** to set values for Entity attributes.
- Use **Edit...** to modify existing assignments. Select the attribute assignment you want to modify from the **Set Attributes** list.
- Use **Remove** to delete a previously defined assignment.

## *Transform Activity*

The Transform Activity changes one type of Entity into another type. A single arriving Entity can be changed into many output Entities (all of the same type.)




### *Dialog Field Definitions and Buttons*

**Output Entities**

- **Quantity** is the number of new Entities to create. This number of each Entity arriving will be generated for *every* Connector exiting the Activity.
- **Entity Type** is the type of Entity to be released. Select the type from the pull-down list.

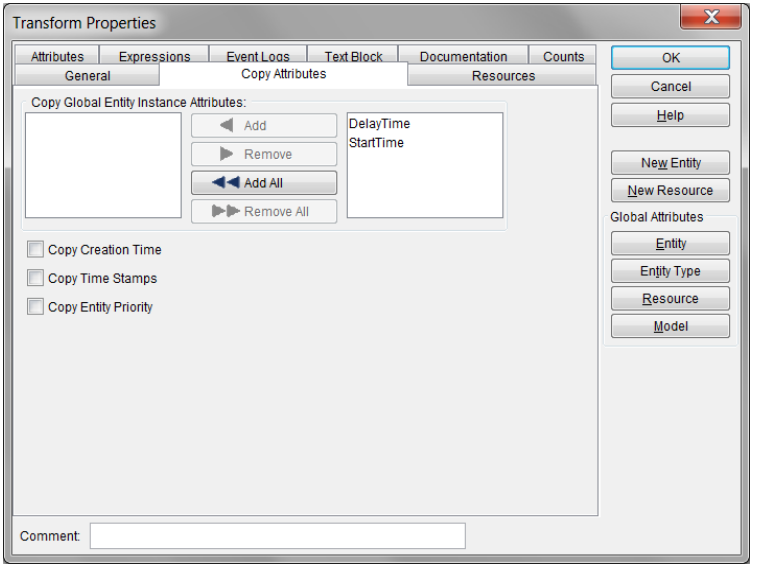
The time specified in the **Duration** will be applied before the transform occurs, thus it will be reflected in the Cycle Time of the incoming Entities. The outgoing Entities will not have accrued any Cycle Time.

**Transfer Resources** causes any assigned Resources of the incoming Entity to be transferred to the exiting Entity. This only applies to Resources that are not acquired and released within the Transform Activity. Thus, Resources requested on the **Resources** tab do not apply since Resources requested there are acquired and released by the incoming Entity before the transform occurs. **Note**: If the **Quantity** is greater than one or there is more than one exiting connector, only the first exiting Entity will receive the Resources from the incoming Entity.

**Copy Attributes** tab is where attributes of the arriving Entity can be selected to be transferred to the new output Entity. Examples of attributes that can be copied include User Defined Attribute values, creation time, etc. Time Stamps and Entity Priority can also be copied.

#### Specifying Attributes to Copy

Selecting the **Copy Attributes** tab displays the following:




The following options on the **Copy Entity Fields and Attributes** tab can be selected:

- **Copy Creation Time** copies the simulation creation time of the original Entity to the transformed Entities.
- **Copy Time Stamps** applies the list of predefined timestamps carried by the arriving Entity to transformed Entities.
- **Copy Entity Priority** applies the priority of the arriving Entity to transformed Entities.

The transformed Entity receives the default Priority value defined in the Entity Type unless it is copied.

User Defined Entity Attribute values associated with the incoming Entity may also be copied. During simulation, different variable types (Integer, Real, Boolean, and String) can be added to an Entity.

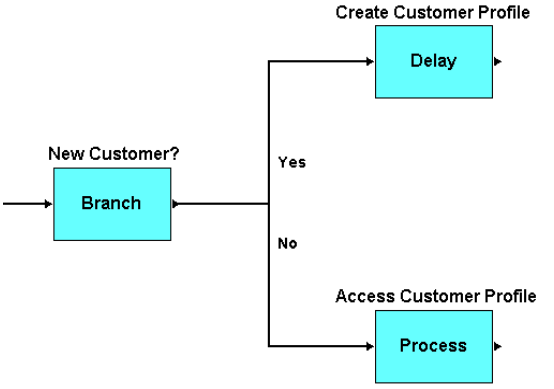
Click on **OK** when finished to leave the dialog, confirming your current selections. The **Cancel** button cancels the current dialog selections.

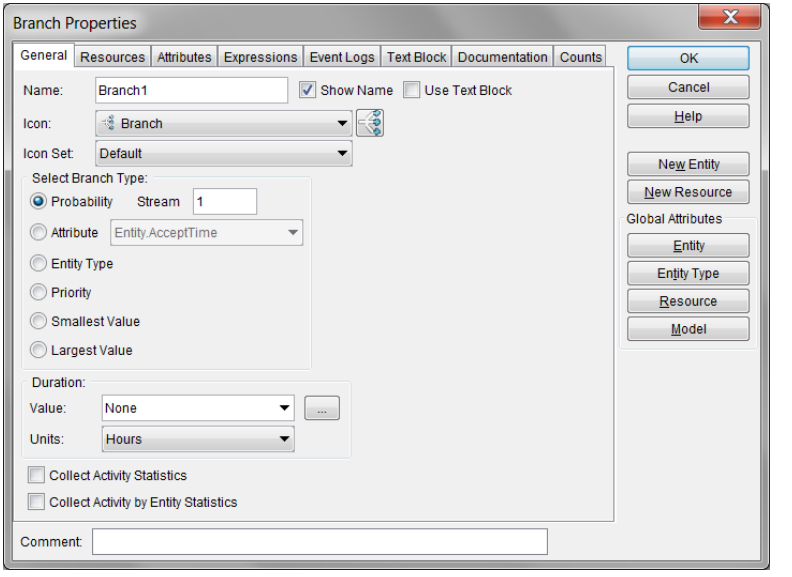
## *Branch Activity*

A Branch Activity routes Entities to different paths of the process model. It allows modeling decision processes, with alternative pathways selected depending on the result.

In the **Branch Activity** detail dialog, you select the type of branching criteria to use: **Probability**, **Entity Type**, **Attribute** value, **Priority**, **Smallest Value**, or **Largest Value**.The precise criteria are specified on the Connectors associated with the Branch.

Consider the case where the order fulfillment process for new customers requires a step that is not needed for repeat customers, such as creating a customer profile. Use different Entities for new customers and repeat customers and branch on **Entity Type**. Alternatively use a single Customer Order Entity and assume that a certain percentage of customers are new and a certain percentage are repeats. Select **Branch Type Probability** and then set the probability of each event on the Connectors leading from the Branch output Pad:




## *Dialog Field Definitions and Buttons*

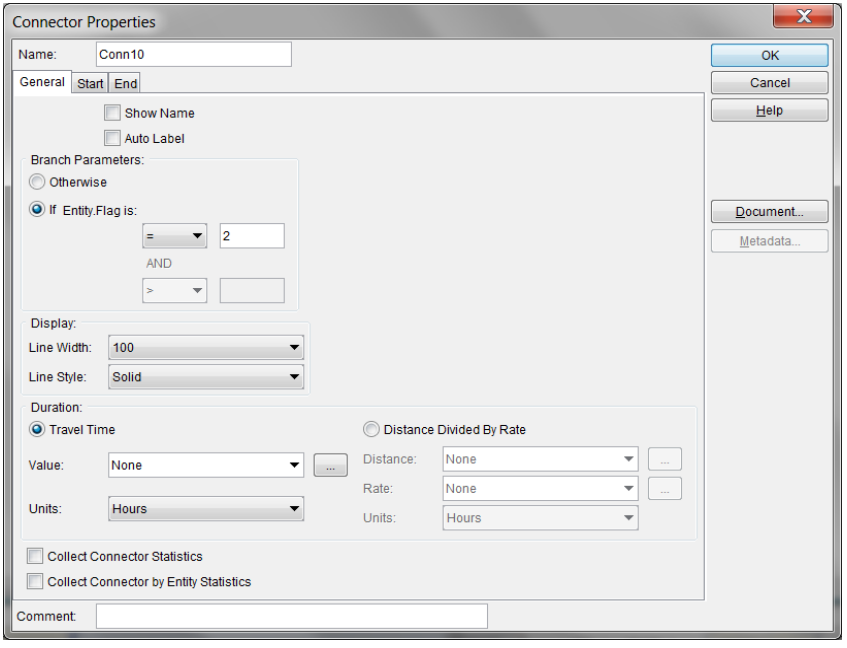
### Select Branch Type

- **Probability.** Entities routed based on a probability specified on each Connector leading from the Branch. All probabilities must sum to 1.0, or one of the Connectors should have the **Otherwise** field set to **True**. **Stream** is the random number stream to use for the probabilities.

- **Attribute**. Route Entities to the appropriate Connector based on values of User Defined Attributes or System Attributes. (See "Using Attributes in SIMPROCESS" for more information on User Defined and System Attributes.)
- **Entity Type**. Route Entities based on type, e.g., send Orders one way and Bills another. Set the Entity Type on the Connectors emanating from the Branch.
- **Priority.** Ability to route higher priority items on one path, lower on another. The priorities are specified on the Connectors.
- **Smallest Value**. Route Entities to the Connector that has the smallest value. The sources for the values are specified on the Connectors.
- **Largest Value**. Route Entities to the Connector that has the largest value. The sources for the values are specified on the Connectors.

### *Branch Connectors*

Connectors link Activities and Processes together. Connector names can assist in labeling a model, e.g., the Entity type that flows. SIMPROCESS will automatically label Connectors emanating from Branch Activities. (See "Connectors and Branch Activities" on page 164 for details.)




The **Branch Connector Properties** dialog contains the **Name** of the Connector, **Comment**, the **Line Width** and **Line Style**, **Branching Parameters, Duration**, **Collect Connector Statistics**, and **Collect Connector by**

**Entity Statistics**.

To display the **Connector Properties**, either double-click on the Connector, right click on the Connector and choose **Properties**, click to select the Connector and click the **Properties** button on the tool bar, or click to select the Connector and choose **Properties** on the **Edit** pull-down menu.

### *Connector Names*

A default Connector name, e.g., Conn44 is assigned. To change the Connector Name, edit the **Name** field in the Connector properties. The **AutoLabel** check box is discussed below.

### *Displaying Connector Names*

The **Edit Preferences** option, on the **Edit** pull-down menu, determines if Connector names are displayed in the model. However, individual **Connector** dialogs have **Show Name** check boxes that will override the model default.

The **Name** field is displayed across the middle of the Connector if **Show Name** is selected.

The **Auto Label** check box applies only to Connectors from Branch Activities. The **Name** will be generated by SIMPROCESS. SIMPROCESS uses entries in the **Connector Detail** dialog box depending on the **Entity Type**.

### *Connectors and Branch Activities*

There are additional fields that appear in the **Connector** detail dialog box when the Connector is connecting a Branch Activity to another Activity or Process. When a Connector emanates from a Branch Activity, use the **Branch Connector Properties** dialog box to specify the branching parameters.

The corresponding **Connector Properties** are based on the type of Branch selected in the **Branch Activity Properties** dialog.

**Entity Type** —Select the type of the Entities that should flow along this Connector from the combo box.

**Probability** —Enter the probability (a number between 0.0 and 1.0) that the Entity will flow on this Connector.

**Priority** — Enter the Entity priority number to branch on. Values are from 1 to 100.

> When Entities are contending for Resources, Entities with a higher priority get to use available Resources first. The higher the number, the higher the Entity's priority.

**Attribute** —The first line shows the name of the Attribute selected in the **Branch Properties** box. Branching can be based on the equality of numbers, strings, booleans, or on ranges of numbers. If the

selected Attribute is a local Entity instance or Entity Type attribute, a run time error will occur if an Entity enters that does not have the selected Attribute defined.

**Smallest Value** and **Largest Value** — Use the buttons in **Set Value** to specify the value to use for the Connector. The value can be an **Entity**, **Resource**, **Activity**, **Connector**, **Time Stamp**, or **Model Attribute** value. See "Adding Values To Custom Plots," beginning on page 270 for a description of the values available for each button. Select **Current Value** to use the instantaneous value. Select **Average Value** to use the running average of the value.

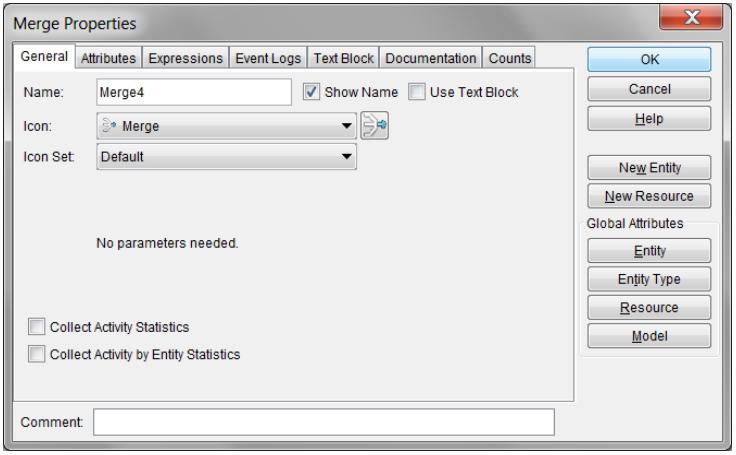
**Otherwise** —If **Otherwise** is selected, this Connector becomes the default branching Connector. This means all Entities pass through this Connector if none of the criteria in any other Connectors are satisfied. For **Smallest Value** and **Largest Value**, the **Otherwise** Connector is only selected if the values for all the other Connectors are equal. If there is no **Otherwise** Connector and all the Connector values are equal, then SIMPROCESS selects a random Connector.

| Branch Activity Type | Connector Properties Used | Display Example |
|---|---|---|
| Probability | Probability (between 0.0 and 1.0)<br><br>Otherwise (True or False) | 0.75<br><br>Otherwise |
| Attribute | Branch If Attribute Is (value)<br><br>Otherwise, (True or False) | Displays User Defined Attribute Name on Connector with IF or AND conditions, e.g.<br>My Attr1 = 5, or<br>4 < My Attr1 < 7<br><br>Otherwise |
| Entity Type | Type (from Entity type combo box)<br><br>Otherwise (True or False) | Request for Quote<br><br>Otherwise |
| Priority | Priority (Entity Priority 1-100)<br><br>Otherwise (True or False) | 1<br><br>Otherwise |

| Branch Activity Type | Connector Properties Used | Display Example |
|---|---|---|
| Smallest Value | Value from Entity, Resource, Activity, Connector, Time Stamp, or Model Attribute<br><br>Otherwise (True or False) | Entity1:Number Created<br><br>Otherwise |
| Largest Value | Value from Entity, Resource, Activity, Connector, Time Stamp, or Model Attribute<br><br>Otherwise (True or False) | Resource1:Units Busy<br><br>Otherwise |

## *Merge Activity*

A Merge Activity routes Entities from different Connectors into one Connector. Merge can be used to TimeStamp all Entities or to reduce the number of "to and from" Connectors to create a more visually appealing model. Also, a Merge Activity is useful if groups of Activities will be copied and pasted. By using a Merge Activity, Connectors are not lost during the copy and paste.

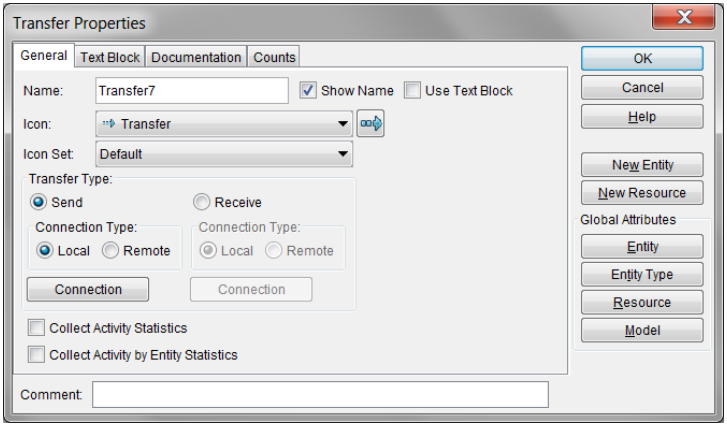



## *Transfer Activity*

A Transfer Activity routes entities without the use of a Connector. Entities can be routed within the same model (**Local**) or to other models (**Remote**) with the Transfer Activity. The **Transfer Type** for a Transfer activity can be **Send** or **Receive**. A sender routes entities to a receiver. Thus, Transfer Activities

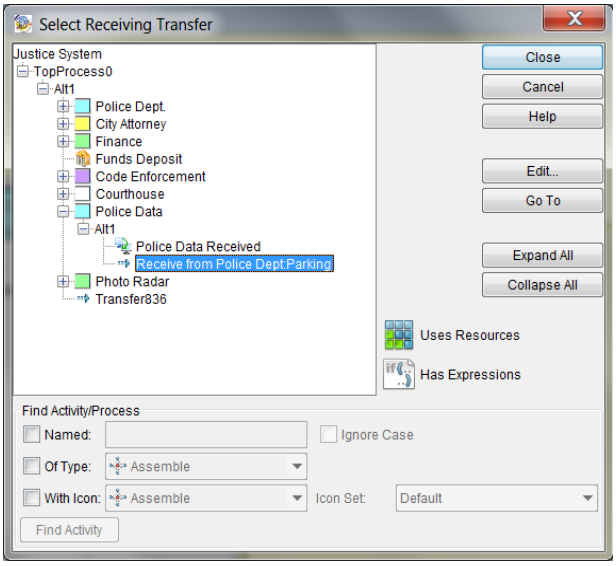
should be used in pairs. Every sender should have an associated receiver. A sender can only connect with one receiver, but a receiver can have multiple senders connected to it. Each **Transfer Type** designates a **Connection Type** of **Local** or **Remote**. **Local** means the Entity transfer will occur within the same model. A **Send** Transfer Activity that is designated **Local** can only connect with a **Receive** Transfer Activity in the same model that has also been designated **Local**. **Remote** means the Entity transfer will occur between models. A **Send** Transfer Activity designated **Remote** can only connect with a **Receive** Transfer Activity in a different model that is also designated **Remote**. Note that for a **Remote** transfer the actual Entity instance from one model is not transferred to another model. Information about the Entity instance entering the **Send** Transfer Activity is sent to the associated **Receive** Transfer Activity in another model. The **Receive** Transfer Activity then generates an Entity that carries the transferred information.

When the activity is placed on the layout, it does not have an input pad or output pad. Selecting **Send** causes an input pad to be added to the activity. Selecting **Receive** causes an output pad to be added to the activity. Once the combination of **Send** or **Receive** and **Local** or **Remote** has been set, it cannot be changed. The Activity must be deleted and recreated if either option needs changing. The default combination for a new Transfer Activity is **Send** and **Local**. The **Connection** buttons operate differently based on the combination of **Send** or **Receive** and **Local** or **Remote**.




### *Local Send Transfer*

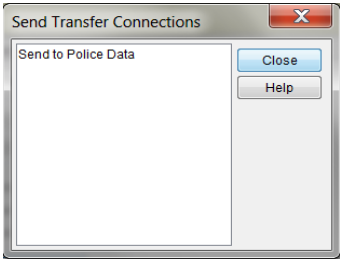
Clicking the **Connection** button associated with **Send**/**Local** brings up a modified version of the Activity Browser dialog. (See "Activity Browser..." on page 34 for more information on using the Activity Browser.) This version includes a **Cancel** button.




All the functions of the dialog are the same as the Activity Browser dialog. Select the receiving Transfer Activity. (The **Find Activity/Process** section of the dialog can be used to search for Transfer activities.) The activity selected when **Close** is clicked must be a Transfer Activity with **Receive** and **Local** selected. An error will occur if the activity selected is not a Transfer activity with **Receive** and **Local** selected. Click **Cancel** to not make a selection or to keep the current selection. Although the selection of **Send** or **Receive** and **Local** or **Remote** cannot be changed once selected, the **Connection** can be changed once set.

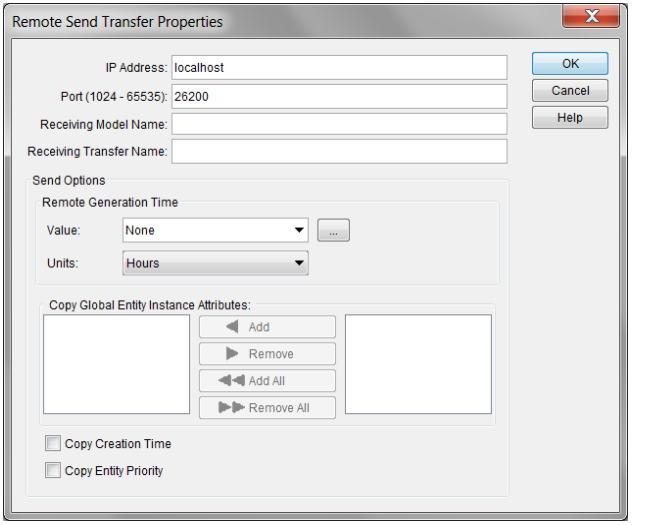
### *Local Receive Transfer*

The **Connection** button associated with the **Receive**/**Local** option displays a list of the **Send** Transfer Activities routing entities to that **Receive** Transfer Activity. No editing of the connections is allowed. The dialog is for informational purposes only.



### *Remote Send Transfer*

When **Send**/**Remote** is selected, the **Connection** button displays the **Remote Send Transfer Properties** dialog.




**IP Address**, which defaults to `localhost`, is the IP Address where the associated Receive Transfer is located.

**Port**, which defaults to `26200`, is the port specified on the **Remote Transfer** tab of the **Run Settings** of the model containing the associated Receive Transfer. (See “Remote Transfer” on page 145.)

**Receiving Model Name** is the name of the model receiving the transferred Entities.

**Receiving Transfer Name** is the name of the Transfer Activity in the model that will receive the transferred information. The name of this Transfer Activity must be unique within the model, and it must be specified as **Receive** and **Remote**.

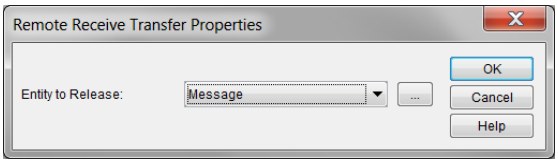
The remaining items are optional. **Remote Generation Time** is the time that the receiving Transfer Activity should release the Entity associated with the transfer. When **None** is selected as the distribution, the Receive Transfer Activity releases the associated Entity when the transferred information is received. Unless the Time Server (page 142) is used for time synchronization this option should probably not be used.

Also optionally, global Entity Attribute values (see “Creating a User Defined Attribute”), Entity creation time, and Entity priority can be included. If user-defined Attribute values are included, the receiving model must have the same global Entity Attributes defined. The Attribute name in the

receiving model must match the Attribute name in the sending model, the Attribute mode (Real, Integer, Boolean, String, or Object) in the receiving model must match the Attribute mode in the sending model, and the Attribute Array Size in the receiving model must match the Attribute Array Size in the sending model. As with **Remote Generation Time**, **Copy Creation Time** should only be used when there is time synchronization.

### *Remote Receive Transfer*

When **Remote**/**Receive** is selected, the **Connection** button displays a selection box that contains the Entity Types defined in the receiving model.




Select the Entity Type to use when an Entity instance is released. Any transferred Attribute information is added to the released Entity instance. The Detail button (three dots) displays the selected Entity Type's properties, which can then be changed.

### *Remote Transfer Operation*

Models that contain Transfer Activities designated **Receive** and **Remote** change simulation behavior to mimic the behavior of models that contain External generation schedules. The simulation will pause instead of end when no more events are scheduled for the simulation clock. (See "Adding an External Schedule" for more information.) Thus, models containing remote receiving Transfer Activities should be started before models that contain the associated remote sending Transfer Activities. The simulation for a model with remote receiving Transfer Activities must be stopped manually or by some method within the model (for example the count limit of the Dispose Activity). When the simulation is started, an internal Remote Transfer Server automatically starts that uses the port specified in the **Remote Transfer** tab of the Run Settings (page 145). This server listens for transfers from one or more sending models. (As stated above, an actual Entity instance is not transferred, just information that is used to cause an Entity to be released from the receiving Transfer Activity.) The server shuts down automatically when the simulation is stopped. Errors that occur in the sending simulation will only stop the sending simulation. Errors that occur in the receiving simulation will stop the receiving simulation but will eventually cause an error in the sending simulation since the Remote Transfer Server will cease operation. If the receiving simulation receives information from the sending simulation that includes a remote generation time less than the current simulation time of the receiving simulation, that information is ignored so no Entity instance is released. The file `simprocess.err` in the SIMPROCESS working directory (see "SIMPROCESS Working Directory") logs when this happens.

Models can function as senders and receivers; however, all receiver models must have unique ports

specified on the **Remote Transfer** tab of the **Run Settings**. Also, note that communication delays can impact the effectiveness of the Remote Transfer capability.

For the user with Java programming experience an external application can be written that sends the same information to a receiving model. The application must create an instance of `RemoteTransferEntity` (in package `com.simprocess.sp.entity`, which is in `simprocess.jar` located in the `SPSYSTEM` directory). The constructor takes five parameters

- `modelName` : String (The name of the receiving model.)
- `transferName` : String (The name of the receiving transfer.)
- `simTime` : double (The time to release the new Entity instance, 0.0 for the current simulation time of the receiving model.)
- `timeUnit` : String (The time unit associate with `simTime`. Must be a valid SIMPROCESS time unit.)
- `sendingTransferName` : String (The name of the sending Transfer Activity. For an external application any valid String will suffice.)

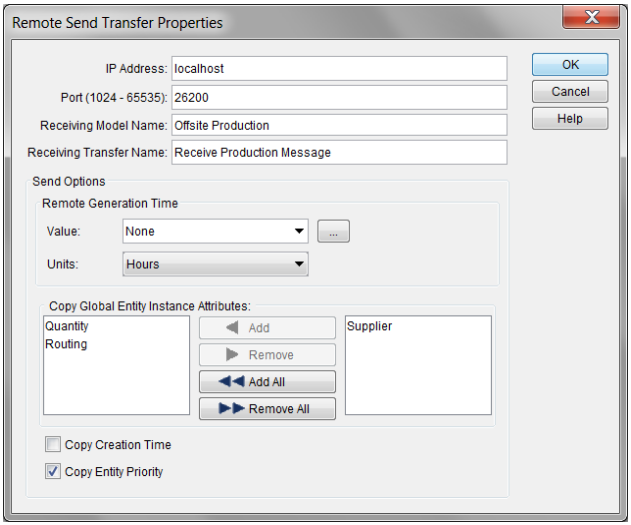
Call the public method `addAttribute(String name, Object value)` to add Attribute information. Again, the Attributes must exist in the receiving model. Use `CreateTime` for `name` to set the releasing Entity's creation time, and use `Priority` for `name` to set the releasing Entity's priority. The `value` for `CreateTime` must be a Double, and the `value` for `Priority` must be an Integer. The instance of RemoteTransferEntity must be sent to the receiving model using a Java Socket (`java.net.Socket`) created with the IP address and port (specified on **Remote Transfer** tab of **Run Settings**) of the receiving model. The receving model will return the String "Success" if there were no errors. Below is the constructor and all public methods of `RemoteTransferEntity`.

- `public RemoteTransferEntity(String modelName, String transferName, double simTime, String timeUnit, String sendingTransferName)`
- `public void addAttribute(String name, Object value)`
- `public String getModelName()`
- `public String getTransferName()`
- `public double getSimTime()`
- `public String getTimeUnit()`
- `public HashMap<String, Object> getAttrMap()`
- `public String getSendingTransferName()`

### *Remote Transfer Example*

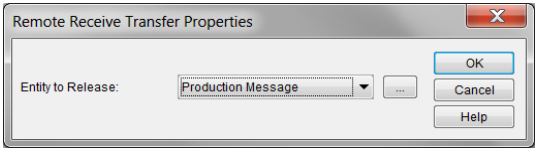
As an example, consider two manufacturing or production models on the same machine, one representing on-site production and the other representing off-site production. The on-site production

model contains a Transfer Activity designated as **Send** and **Remote** with the following properties.




Note that **`localhost`** is used for **IP Address** since both models are on the same machine. The **Port**, **`26200`**, is the port specified in the **Run Settings** of the model **Offsite Production**. The name of the Transfer Activity that will receive the transferred information is **Receive Production Message**. No **Remote Generation Time** is passed. The Entity instance Attributes **Quantity** and **Routing** are included along with the sending Entity's priority.

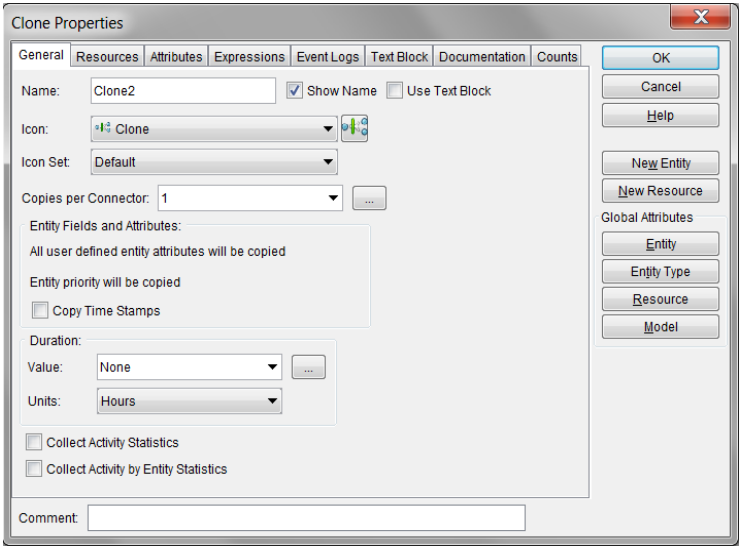
In the receiving model **Offsite Production**, the **Connection** properties for the Transfer Activity **Receive Production Message** (designated as **Receive** and **Remote**) show that instances of the Entity Type **Production Message** will be released.




## *Clone Activity*

The Clone Activity generates duplicate Entities. Note that this activity is only available from the **Create** menu. This is because the Clone activity exists primarily to support pre-SIMPROCESS version 4.0 models. Since the cloned entities leaving the Clone activity are of the same type as the entity entering

the activity, the entity statistics for the type of the entering activity are affected by the creation of the cloned entities. The entity statistics are skewed by the Clone activity. The Split activity is the recommended activity for entity cloning since the cloned entity can be a different type of entity. Thus the statistics for the original entity are not affected by the creation of cloned entities.




### *Dialog Field Definitions*

- **Number of Copies per Connector** is the number of Entities that will come out the Clones Pad into *each* Connector.
- If a **Duration** is defined for the Activity, the time specified in the **Duration** will be applied before the cloned Entities are created. In other words, it will be reflected in the Cycle Time of the incoming Entities.
- If Time Stamps are defined for the incoming Entity, those values can be passed to the Clones by selecting **Copy Time Stamps**.

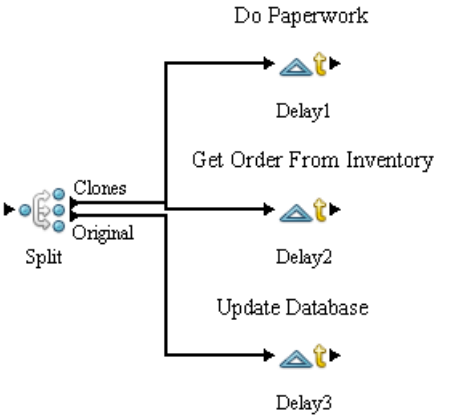
## *Split and Join Activities*

The *Split* and *Join* Activities work together to temporarily split the processing of an Entity among parallel Activities.

At the Split Activity, an Entity is converted into one or more Entities, each of which follow a different path before (optionally) reuniting at a Join Activity.

The Split Activity generates *child* Entities from the *parent* Entity. The children and the parent Entity belong to the same *family*. After going their separate ways, the family is reunited at the Join Activity, where a single Entity, the *parent*, exits for continued processing.

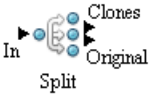
In the order fulfillment process, Split and Join might come into play in the handling of rush orders. To speed up processing of rush orders, the work might be divided among several clerks at some point:




The figure above shows how a Split Activity takes a customer order Entity and releases three Entities, the original and two children (or clones). Each Entity goes to a different Activity, where a different task is performed on the order.

## *Defining a Split Activity*

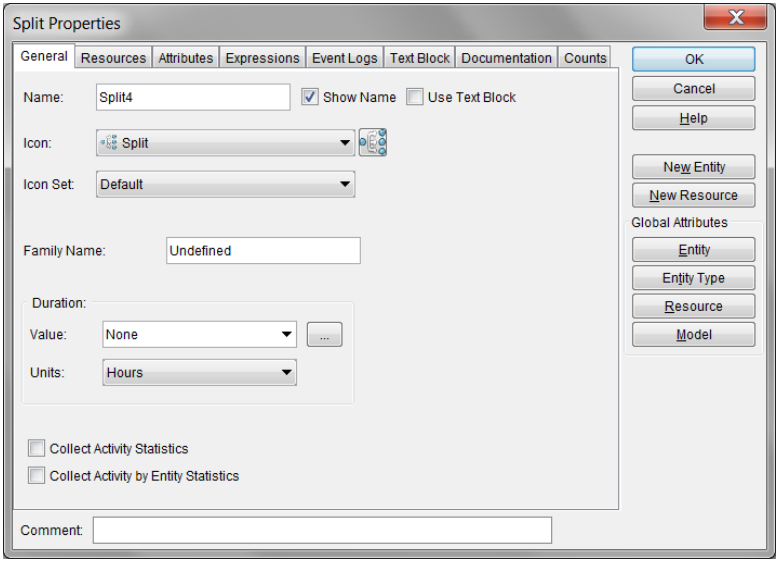
When you add a Split Activity to the SIMPROCESS layout, it has one input Pad and two output Pads attached:




The upper output Pad is named *Clones*; the lower Pad is named *Original* (if you double-click on the Pads, you will see their names in the **Pad Detail** dialog).

Use the Original Pad to route the original Entity to the next Activity in its path. Use the Clones Pad

to route each of the split Entities to their next Activities. An unlimited number of split Entities of different Entity types can be released at a Split Activity, but all Entities emerge from the same Pad.




### *Dialog Field Definitions*

The unique attribute of the Split Activity is:

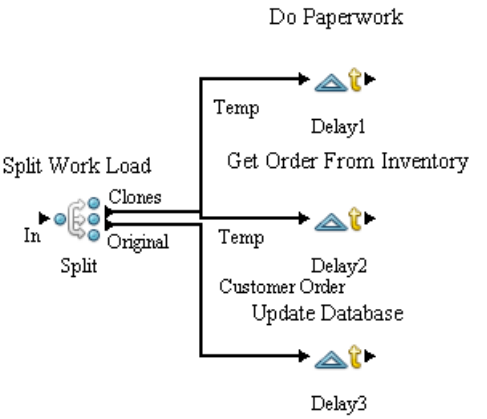
**Family Name**. This names the family of Entities being created. The original Entity and its children can be identified by their common family name. **Family Name** is used at a Join Activity to identify the Entities to be joined. Family names must be unique within a model.

### *Identifying Split Entities*

Split Entities are Attributes of the Connector: a Split Entity is defined for each Connector linking a Split Activity to a connecting Activity.

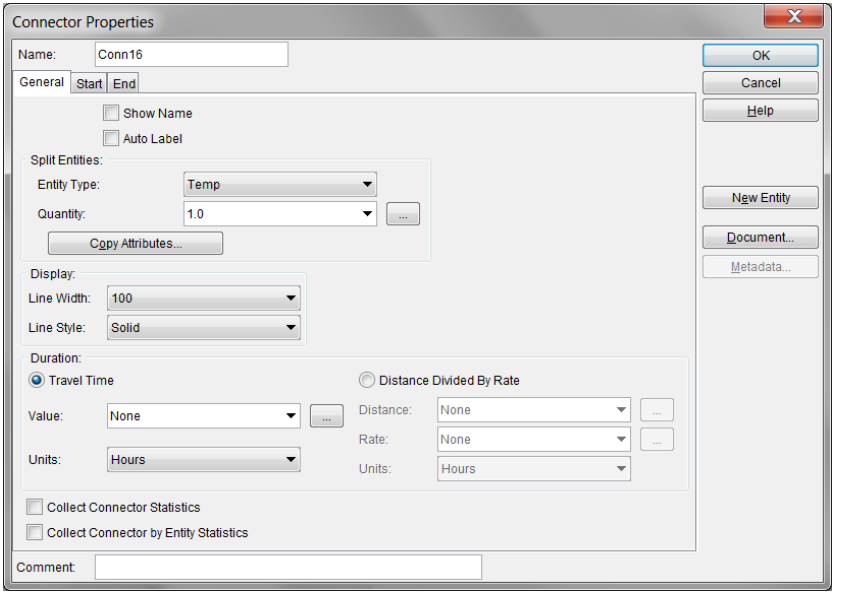
A single Connector is drawn from the *Original* output Pad to an adjoining Activity's input Pad. Then, the *Split* output Pad is connected to the other adjoining Activities.

As an example, the figure below shows the distribution of rush order processing into three simultaneous Activities: paper work, retrieval of an item from inventory, and updating of the inventory database.




The *Original* Pad of the Split Activity is connected to the input Pad of the *Update Database* Activity, so the original customer order Entity flows through *Update Database*.

Double-clicking on one of the Connectors emanating from the Split Pad opens the Split Connector properties.




### *Dialog Field Definitions*

The unique attributes of the Split Connector are:

- **Entity Type** is the field where the Split Entity type that will flow along this Connector is selected.
- **Quantity** specifies how many of the split Entities will flow along this Connector for *each* original Entity that enters the Split Activity.
- **Copy Attributes** opens a dialog where Global Entity Instance attributes to copy from the original Entity to each of the Split Entities are selected. Entity Priority and Time Stamps can also be copied from the original Entity to each of the Split Entities.
- **New Entity** button opens the Entity definition dialog for modifying Entity-type definitions.

Clicking on the **Entity Type** pull-down box displays a list of the Entities in the model. The Entity to flow along this Connector is selected here.

For analysis purposes, consider using a different name for the children. For example, if the original Entity type *Customer Order* is used for each of the paths leading from the Split Activity, distortions in the statistics for the *Customer Order* Entity could occur. When all split Entities meet again at the Join Activity, the two split Entities are destroyed at the Join, while the original Entity continues on.

When total cycle time for *Customer Order* Entities is calculated at the end of a simulation, those split Entities skew the statistics.

Cycle times for the split Entities are measured from generation in the Split Activity to termination in the Join Activity, while the original Entity's cycle is measured from a Generate to a Dispose Activity.

An Entity named *Temp* is defined and used on the Split Connectors in the case of Rush Order Processing in order not to skew the cycle time or Entity count statistics for Customer Order Entities.

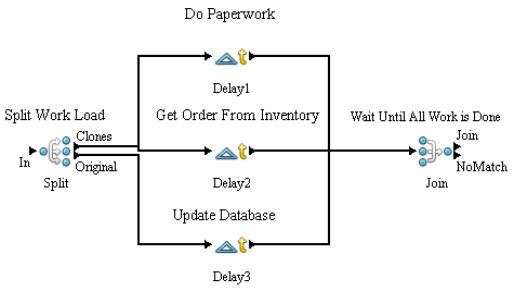
Note that using an Entity named *Temp* for split Entities is adequate if the simulation statistics of these Entities is not important. Define a different Entity type for each Split path if the number of each split Entity generated during a simulation is important, or any other Entity statistic is important.

Select the **Auto Label** option if you want SIMPROCESS to display the Entity name on the Connector. The name will be displayed unless **Show Name** on the Connector is turned off.

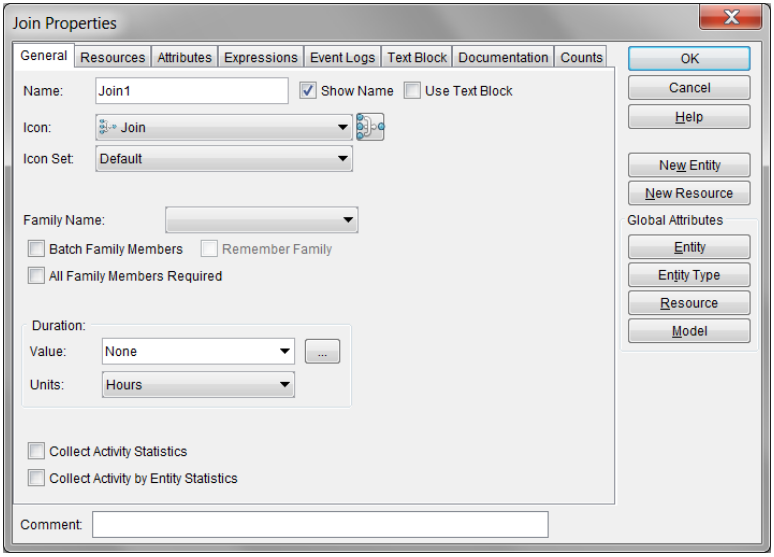
Click on **OK** when you finish defining the Connector.

## Defining a Join Activity

Entities released from a Split Activity are reunited at a Join Activity.




The Join Activity icon has one input Pad and two output Pads. The upper output Pad is named *Join*; after reuniting with their family, the original Entity exits through this Pad. The lower Pad is named *NoMatch;* Entities that are not members of the Join family leave through this Pad. An Entity that is not a member of the Rush Order family that enters the Join Activity will pass through the Join Activity and exit through the **NoMatch** Pad. Note that no processing time will apply even if a delay duration is specified.




### *Dialog Field Definitions*

**Family Name** identifies the Entity family to be joined. The pull-down list for **Family Name** contains the names of all families that have been defined in the model. Family names do not have to be unique in Join Activities, i.e., two Join Activities could use the same family name. This would be done if the same split Entities needed to be joined twice. The exiting Entity could be a batch that could be later unbatched and joined again after further processing (see **Batch Family Members** and **Remember Family**).

**Batch Family Members** tells SIMPROCESS to batch the child Entities with the original Entity. (The Entity can be separated into its components at an Unbatch Activity.) Otherwise, all the child Entities are disposed in the Join Activity. SIMPROCESS releases the original Entity through the *Join* Pad.

**Remember Family** is only enabled when **Batch Family Members** is selected. This is an advanced option that should only be considered for higher level modeling. By default, when an Entity, whether batched or not, leaves a Join Activity, the family references are removed. However, if **Remember Family** is selected, the batched Entity that leaves the Join Activity and the Entities in the batch keep the family reference. If the Entity exiting the Join Activity is later unbatched, the individual Entities can then be routed back to the original Join Activity or another Join activity with the same family selected for rejoining and/or rebatching. If the individual Entities are routed back to a Join Activity with the same family and **Remember Family** was not selected on the original Join Activity, the Entities will exit through the **NoMatch** pad. This option should not be used if the exiting Entity will eventually be routed back to the original Split Activity. Splitting again will cause the Entities to never leave the Join Activity. A batched Entity that exits a Join Activity with **Remember Family** not selected can be routed back to the original Split Activity. The new child Entities are simply added to the batch at the Join Activity.

By default, **All Family Members Required** is not selected. When the original Entity enters a Dispose Activity or is otherwise destroyed before it reaches a Join, SIMPROCESS releases one of the child Entities at the Join Activity. Which child Entity is released cannot be specified; SIMPROCESS selects it.

Note that if any of the child Entities are disposed before they reach their Join Activity, the rest of the family still reunites at the Join; if the rest of the family is already at the Join Activity at the moment the child Entity is destroyed, SIMPROCESS processes and releases the original.

If **All Family Members Required** is selected, then no Join will occur until all family members (children and parent) arrive at the Join Activity. Thus, if any members of the family are disposed before the Join, then the remaining family members will remain queued in the Join Activity.

CHAPTER 5

# *Resource Modeling Constructs*

A Resource is an agent that is required to perform the tasks associated with an Activity. People, equipment, vehicles, money, and space can be modeled as Resources. The limited availability of Resources is an important constraining factor in business processes.

- A bank customer requires the help of a loan officer in order to submit a loan application.
- On a manufacturing line, a computer board cannot be populated with chips unless both an operator and a surface mounting tool are available.

The loan officer, the operator, and the surface mounting tools are Resources whose availability affects the activity in these examples.

SIMPROCESS provides the means for modeling Resources and for measuring the impact on the performance of a business process. In addition, variable and fixed costs associated with Resources may be used to measure Process costs and activity costs. See Chapter 7, "Activity-Based Costing," beginning on page 219 for more details.

This chapter describes how to:

- Define Resources
- Define the Resource requirements of Activities
- Use Resource related activities such as: Get Resource, Free Resource, and Replenish Resource.

# Resources and Simulation

When an Entity arrives at an activity, SIMPROCESS checks to see if any Resources are required to process it. If Resources are required, SIMPROCESS attempts to obtain them. Once an activity gains control of one or more units of a Resource, those Resource units are unavailable to any other activity. The activity retains control of the Resource units until it finishes Processing the Entity.

## *Resource Allocation Policy*

During simulation, many activities may simultaneously contend for units of the same Resource. If a required Resource is not available when an Entity arrives at an Activity, the Entity waits for that Resource in a queue. This state is defined as "Wait for Resource" in the SIMPROCESS Standard Report.

If an activity requires units from two different Resources and units from only one Resource is available, SIMPROCESS may or may not obtain the Resource units that are available. It depends on the rules defined for the Activity. Any Resource units an activity holds are unavailable to other activities.

SIMPROCESS attempts to satisfy Resource requirements in the order of the priority of Entities queued for the Resource. Priority is an Entity attribute assigned when the Entity is defined. All Entities with the same priority are treated on a first-come, first-served basis. A higher priority Entity may (optionally) preempt a lower priority Entity when the Resource units needed are not available. See "Preempting Lower Priority Entities" on page 195.

# Defining Resources

Use the **Resource** option from the **Define** pull-down menu or the **Define Resources** button on the Model Toolbar to define Resources in a model.

In the following discussion, Resources for an order distribution Process will be used: sales representatives to Process the orders, trucks to deliver merchandise, and fuel to power the trucks.

The **Resources** dialog is used to define new Resources, modify existing Resource definitions, copy Resource definitions, or delete Resources. The **Add** function creates a new Resource definition. The **Edit, Remove**, and **Copy** functions are only active if there are existing Resource definitions. These functions operate on the Resource selected in the table:

- **Edit** modifies an existing Resource definition.
- **Remove** deletes a Resource definition.
- **Copy** creates a new Resource based on the definition of an existing one.
- **Type** specifies the Resource template that will be used to create a new Resource definition.
- **Undo** restores a Resource that has been removed.
- **Add Template** saves the Resource definitions for re-use. Templates are discussed in "Adding Resource Templates".

The meaning of the label **Defined in OrgModel** is discussed in the *SIMPROCESS OrgModel Manual* (see "Assigning OrgModels").

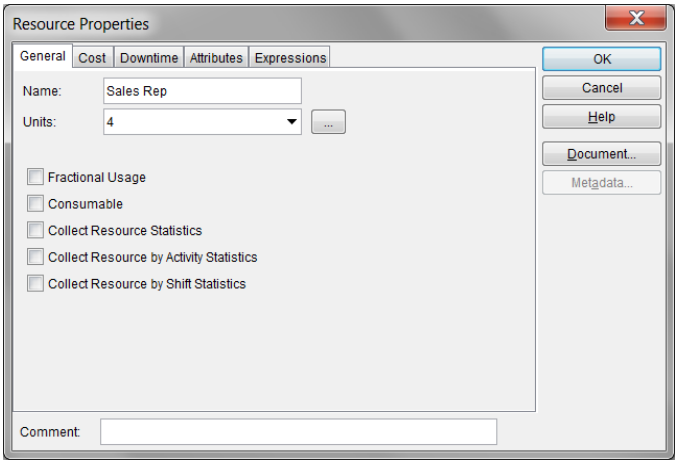
SIMPROCESS has one pre-defined Resource type which can be used when defining a new Resource. New Resource templates can be created and added to the **Type** list. (See "Adding Resource Templates" for more information on Resource Templates.) When the **Add** button is chosen, a new Resource with

the characteristics of the **Type** selected will be created. The pre-defined type is a default Resource:

- One unit of resource.
- No downtime defined.
- No costs defined.
- No Attributes or Expressions defined.

See "Resource Downtime" for more information on Resource Downtime.

Click on **Add** to define a new Resource:




On the **Resource** dialog **Name** is any unique name identifying the Resource. Define the sales clerk staff, and name the Resource *Sales Rep*.

**NOTE**

Special characters, such as "/", "+", single quotes, or "-", should not be used in the **Name** of a Resource. This adversely impacts statistics and cost data collection.

**Units** identifies the initial capacity of the Resource. If the Resource is not consumable, capacity is constant throughout the simulation. If the Resource is consumable, capacity will vary over the length of the simulation. This fluctuation in capacity will be reflected in the capacity statistics in the Standard Report. Number of **Units** of a Resource can also be specified with a single line Expression, or a User-defined Attribute. See "Variable Resource Usage" for more information.

**Fractional Usage** indicates whether or not fractional units of the Resource can be allocated. If this box is checked, a non-integer value for **Units** (e.g., 2.5, 10.2) may be defined. It also means that an activity can

acquire a fractional part of the Resource.

**Consumable** is used to identify resources that cannot be released and reused later, such as paper or oil. They must be replenished before demand is greater than supply.

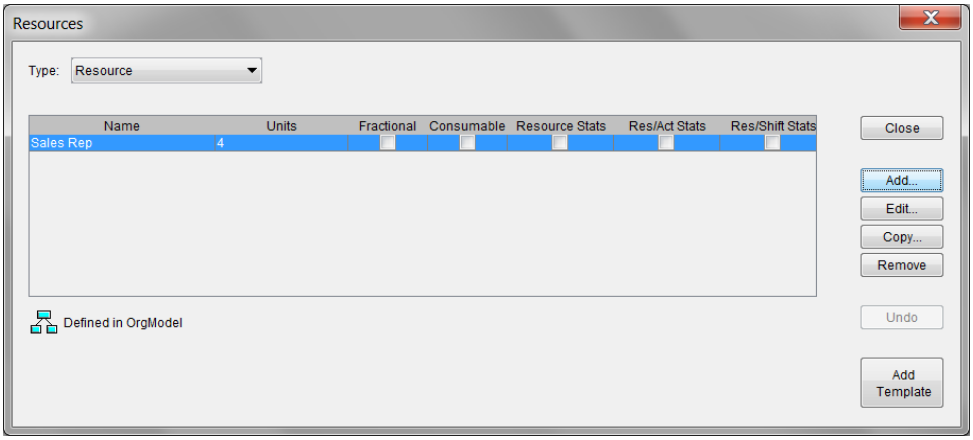
The **Cost** tab allows cost values to be assigned to Resources and keeps track of the expense involved in using Resources. This function is described in detail in Chapter 7, "Activity-Based Costing," beginning on page 219.

**Expressions** tab provides the means of writing specialized Processing instructions.

The **Attributes** tab defines attributes for the Resource. Attributes are customized variables. Typically, expressions include Processing of attributes. These topics are discussed in depth in "Customizing a Model with Attributes and Expressions".

The **Document** function is used the same way it is for Activities, to store descriptive text about the Resource. The default headings can be customized. (See "document Subdirectory".)

The **Downtime** tab is where the periods when the Resource will *not* be available in the model are defined. Resource downtimes are described in "Defining Downtime Schedules of Resources"

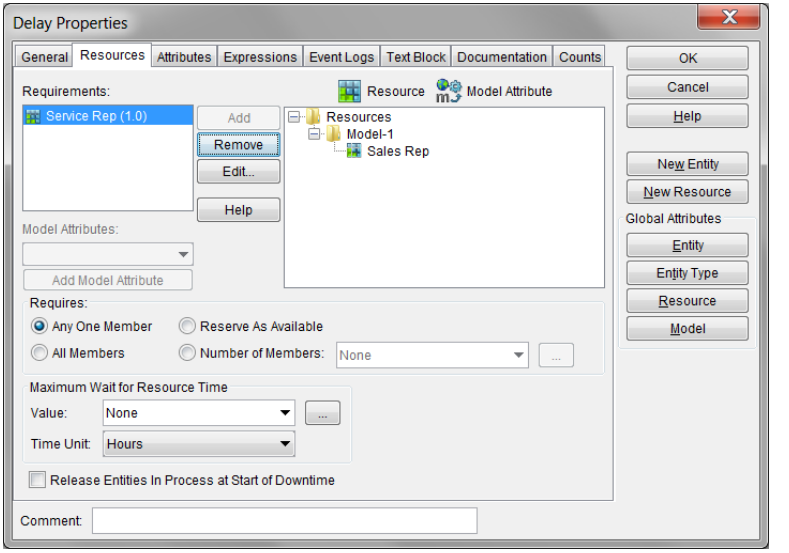



Note that the basic properties of Resources added to the model can be edited directly from the table. However, changes made in the table are direct changes to the properties of the Resource and cannot be canceled. Also, the table can be sorted by a particular column by clicking on the column header. Holding the **Shift** key while clicking on a column header causes the table to sort in the reverse order.

# Adding Resource Requirements to Activities

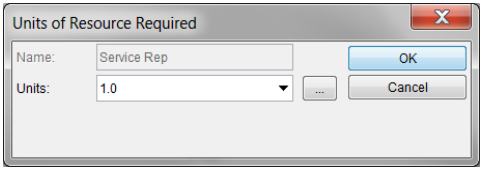
Once the model flow and resources are defined, the Resource requirements of each Activity must be added to the model.

The Resource requirements for an activity are defined on the **Resources** tab of the **Activity Properties** dialog box.




The Resources are listed in a tree structure and are identified by the Resources icon. All the other items in the tree are Resource groups. For example the top item in the tree is **Resources**. To add all Resources in the tree to the **Requirements** list, select **Resources** and click **Add**. The items directly subordinate to **Resources** are the names of the SIMPROCESS model and any SIMPROCESS Organization and Resource Models (OrgModels) assigned to the SIMPROCESS model. (See "SIMPROCESS Organization and Resource Models" for more information on creating and using SIMPROCESS OrgModels.) Selecting the SIMPROCESS model name (**As-Is** in the example above) and clicking **Add** adds all the Resources in the SIMPROCESS model group to the **Requirements** list. Multiple individual items in the tree can be added at the same time by pressing the Control key when selecting Resources.The units required default to 1.0 when Resources are added to the **Requirements** list. Model Attributes can also be used to specify Resource requirements. (See "Varying Resources".)

Use **Edit** to modify an existing requirement definition.




Any existing resources will be listed under the **Requirements** heading. Highlight the resource allocation to be modified, and press **Edit**. Units may be a constant or a distribution. Resource requirements can also be set by using the **Evl** function with User-defined Attributes. (See "Varying Resource Units".)

If the units requested are larger than the defined capacity of the Resource and the Resource is not a consumable Resource, a runtime error will occur. However, if the Resource is a consumable Resource, the Entity will remain in the wait for Resource queue. Entities remain in the wait for Resource queue until the consumable Resource has been replenished to a level at or above the required allocation.

**Remove** deletes the requirement highlighted in the **Requirements** box.

Once a list of Resources has been chosen for the activity, the combination of Resources in the **Requires** area may be specified.

**Requires** defines the combination of Resources required to perform this activity:

- **Any One Member** — any one of the Resources listed is sufficient to perform the task.
- **All Members** — all members in the **Requirements** list are needed in order for this activity to Process an Entity. SIMPROCESS does not obtain any member until all the required Resources are available.
- **Reserve As Available** — all listed Resources are required and will be reserved as they become available.
- **Number Of Members** — A certain number of members of the list (but not all members) are needed to Process an Entity. Enter the value of number in the box.

**Reserve As Available** may pose a risk of deadlock.

Activities A and B are both defined as requiring Resources 1 & 2, using **Reserve As Available** logic. An Entity arrives at activity A, which obtains Resource 1. Resource 2 is not available, so A waits for it.

Now an Entity with higher priority arrives at Activity B. Activity B waits for Resources 1 and 2. Then Resource 2 becomes available. Although Activity A has been waiting for Resource 2 longer than Activity B has, B gets the Resource because the Entity it is processing has a higher priority than Activity A's Entity. A deadlock develops since neither activity will release the reserved Resource. Make sure this situation cannot develop.

**Maximum Wait for Resource Time** is used to set the maximum amount of time an Entity will wait for the requested Resources to become available. The **Value** field can be None, a constant, or any valid statistical distribution and will represent units as selected in **Time Unit**. A **Value** of None indicates that the Entity will wait as long as necessary to obtain the requested Resources. If **Value** is something other than None and the Entity is still waiting for Resources when the specified time has passed, the Entity leaves the Activity without processing. When this occurs, the Entity System Attribute `EndWait` is set to TRUE. (See "Customizing a Model with Attributes and Expressions" and "System Attributes" for information on SIMPROCESS System Attributes.) Thus, `EndWait` can be checked to determine whether an Entity exited an Activity without processing and the Entity can be routed appropriately. (**Important**: `EndWait` is not automatically reset to FALSE. This must be done in an Expression once the current value of `EndWait` is no longer needed for Entity routing.) For Activities that collect statistics, Entity Counts for Entities that exit without processing are displayed in the `Total Not Processed` category of the Activity Entity Count statistics (page 254) in the Standard Report (page 243). Note that there is also a `MaxWait` System Attribute that can be used to set the maximum amount of time that an Entity will wait for requested Resources (see "Setting Maximum Resource Wait With Expressions").

**Release Entities In Process at Start of Downtime** sets whether Entities are released when Processing is interrupted by Resource downtime. This option is not available on the Resource usage dialog of the Get Resource activity. This is because Get Resource activities have no delay for Processing. (See "Defining Downtime Schedules of Resources".)

# Explicitly Getting and Freeing Resources

When an Entity arrives at an activity, if a Resource is listed in the Resource requirements list for the activity, SIMPROCESS attempts to obtain the Resource required to process the Entity. If the required Resource or Resources are not available, the Entity waits until the Resources become available. When processing is completed, the activity releases the Entity and frees the Resources.This is an implicit way to get and free a Resource. However, some business processes require more control over resource allocation. The Get Resource and Free Resource options allow the model to explicitly control the allocation of Resources.

A clerk may perform a series of activities, and it is necessary that the same clerk execute all the activities in a given order. Therefore, the model should "Get" the Resource, perform all the activities and then "Free" the Resource. The remainder of the section will describe how to model this series of actions with SIMPROCESS.

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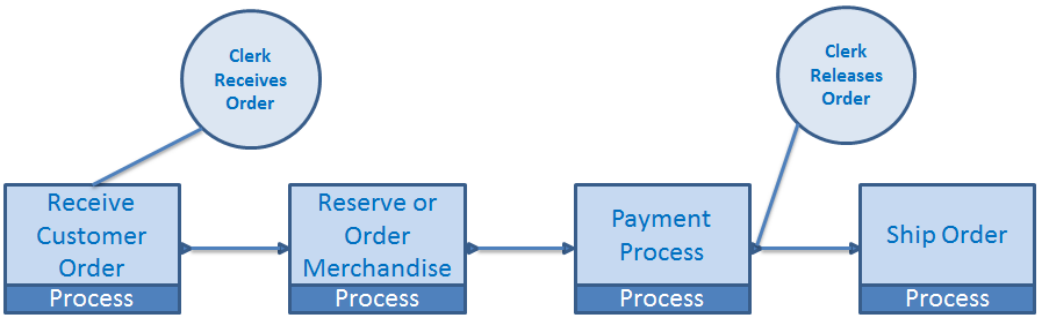


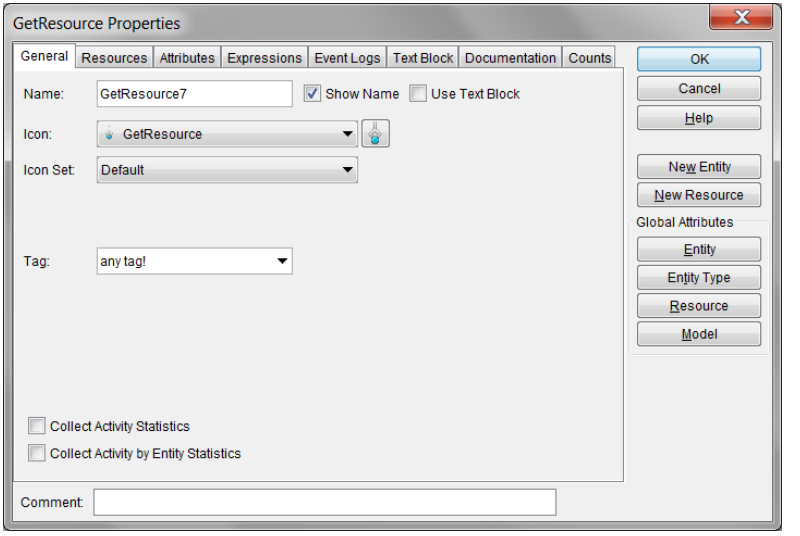

## *Get Resource and Free Resource Activities*

### *Get Resource Activity*

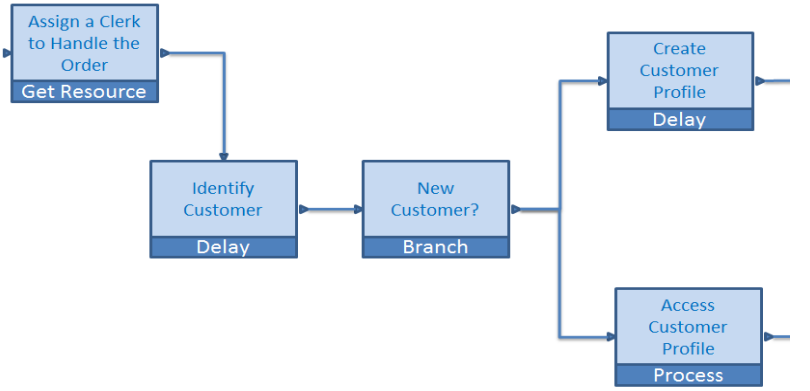
The **Get Resource** activity obtains a Resource and holds on to it across multiple Processes and activities.

Assign a unique **Tag** to each **Get Resource** activity. Although it is possible to use the same **Tag** twice at different levels of the model hierarchy, it is highly discouraged.

In the **Get Resource Activity Properties** dialog, click on the **Resources** tab to specify the Resources to be allocated. Fill out the **Resources Usage** dialog as specified in "Adding Resource Requirements to Activities" on page 186.



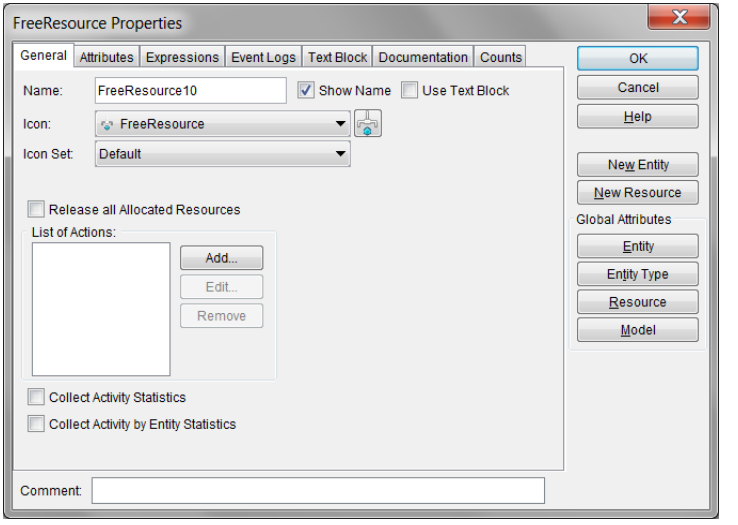

The *Access/Create Customer Profile* Process is shown with a Get Resource activity added:




**Get Resource** obtains Resources that would otherwise have been obtained in the ensuing activities. Do not define the same Resource requirement in those activities as well.

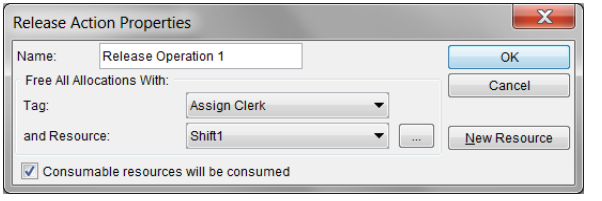
### *Free Resource Activity*

The **Free Resource** activity is used to release Resources obtained at a **Get Resource** activity.




All Resources that have been allocated for this Entity can be freed by clicking on the **Release all Allocated Resources** box.

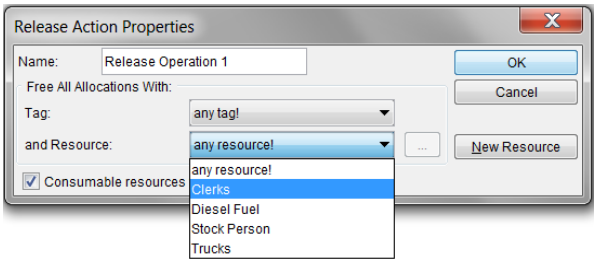
An explicit set of Resources to be freed can be defined by clicking on the **Add** button in the **FreeResource Activity Properties** dialog box. The **Add** button brings up the following dialog.




Assign a **Name** to the action being defined. This name will be displayed in the **List of Actions** field of the **FreeResource Properties** dialog box.

The **Tag and Resource** fields combine to define free Resource actions:

1. **Tag** indicates the **Get Resource** activities whose Resources will be released. The pull-down list contains all the **Get Resource** tags in the model.




A tag may be selected from the listbox, or **any tag!** may be specified, which causes the free action to ignore the tag assigned at the Get Resource activity.

If more than one Get Resource activity was used, separate free actions can be defined for each set of Resources to be freed.

2. Use the **Resource** pull-down list to specify the Resource being freed, or select **any resource!** to free all Resources allocated for the Entity. Resources are only freed if they were obtained in the activities specified in the **Tag** field. Model Attributes can also be used to specify the Resource to release. See "Varying Resources" for more information.

   To release more than one Resource, but not all the listed Resources, create a separate action for each.

3. Select **OK** to accept the definition. The action now appears in the **List of Actions** schedule.

You can add additional actions to the list by clicking on **Add** and defining the action.To modify the definition for an action item, highlight it in the listbox and click on **Edit**. To remove the action, click on **Remove**.

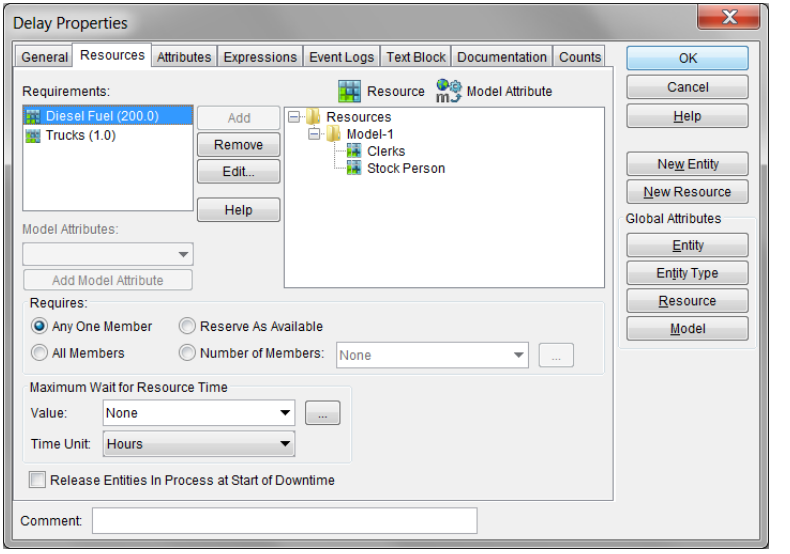
SIMPROCESS provides the option of whether or not to deduct the amount acquired from consumable Resources when those Resources are freed. Click on the **Consumable Resources will be consumed** check box in order to decrement consumable Resources. For example, a **Get Resource** activity obtains 50 gallons of Diesel Fuel in anticipation of shipping merchandise to a customer. Before reaching the shipping activity, the Entity enters a Branch activity in which the merchandise order is canceled. In this situation, one branch of the path leads to a **Free Resource** activity where the consumable Resource is not consumed, since it was not used. The other path continues on to the shipping activity, and then to a **Free Resource** activity in which the fuel Resource is consumed.

Getting and freeing Resources can also be accomplished using expressions. (See "Getting and Freeing Resources Using Expressions".)

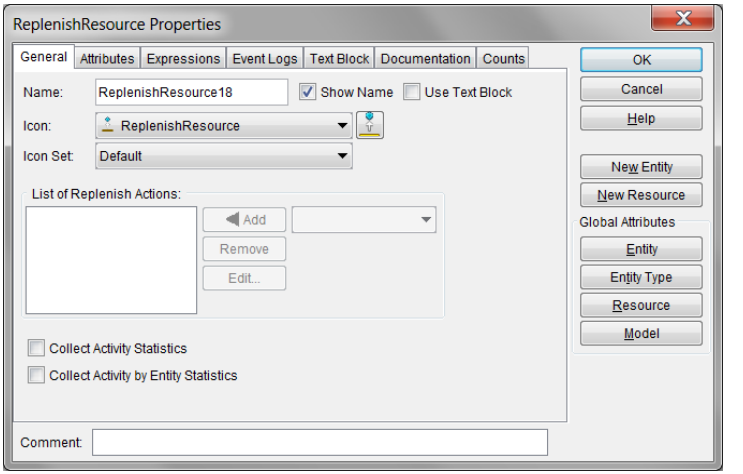
# Replenishing Consumable Resources

The **Replenish Resource** activity is used to replenish a consumable Resource during a simulation.

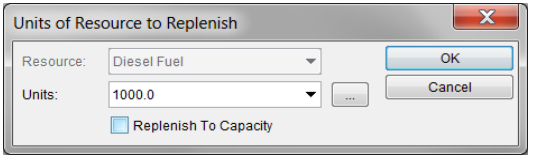
Diesel fuel is a consumable resource used when shipping merchandise. Once an order is made, the truck and a quantity of fuel will be allocated as Resources to perform the shipping. The fuel quantity is deducted from the inventory and gets replenished by a daily shipment received each morning.




Double-click on the **Replenish Resource** icon to define this action.




Select the consumable Resource on the drop down menu, and then click on **Add** to define a replenish action:



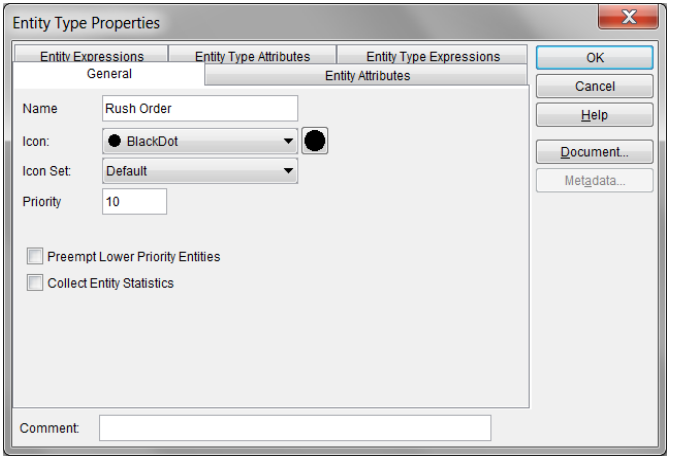

The **Resource** field identifies the Resource to be replenished. The pull-down list shows all the consumable Resources defined in the model.

**Units** indicates the quantity of the Resource to be added either in a real number or a statistical distribution. The distribution can be selected from the pull-down list of the **Units** field. The **Replenish to Capacity** box indicates that a Resource should be replenished only up to the value specified in its **Units** field when the Resource was defined.

Note that Resources can also be replenished using expressions. (See “Changing Resource Capacity With Expressions”.)

# Preempting Lower Priority Entities

A higher priority Entity may preempt a lower priority Entity when the Resources are not available. Selecting **Preempt Lower Priority Entities** on the Entity definition dialog will potentially cause all Entity instances of this type to interrupt Activities processing lower priority Entities.




In this example, if a Rush Order Entity enters an activity that requires Resources, and no Resources are available, SIMPROCESS will check the Entities being processed. If there is a lower priority Entity Processing, the Processing will stop and the Resources will be released. When the Processing is stopped, if the **Interrupt Processing** Entity instance expression has statements, it is executed. The Rush Order Entity obtains the Resources and starts Processing. The Entity that was interrupted goes back to the wait for Resource queue. It will be placed in the queue ahead of all other Entities with the same or lower priority. When the interrupted Entity obtains Resources again, it will Process with the time that was remaining when it was preempted. Also, if the **Resume Processing** Entity instance expressions has statements, it is executed. (See "Initializing Entity Attributes" for information on Entity instance expressions.)

CHAPTER 6

# *Graphical Modeling Constructs*

Graphical constructs in SIMPROCESS include:

- Background Text (static and dynamic)
- Background Graphics

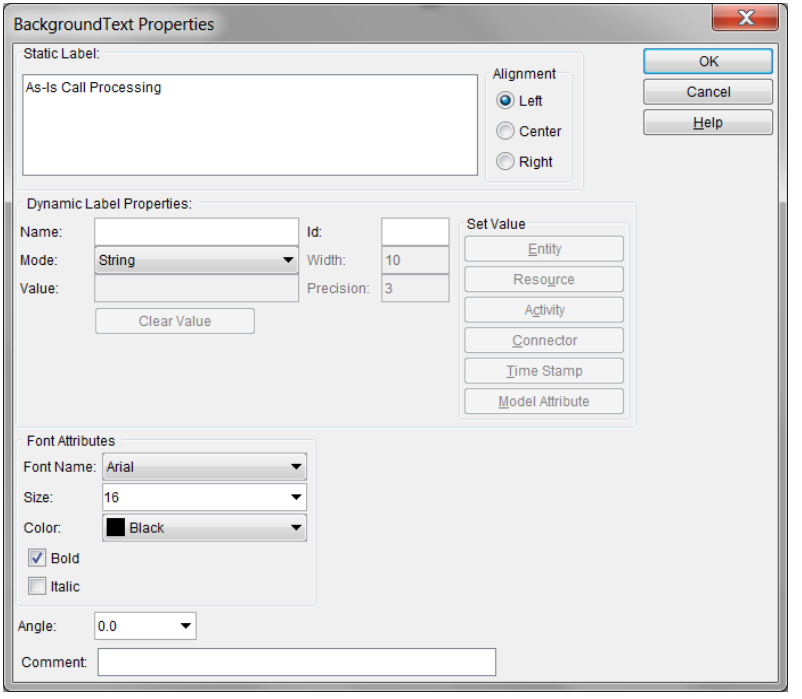
In addition, graphics can be imported for use as backgrounds or icons, Activity Gantt charts can be created, and animation can be recorded for playback.

# Background Text

There are two types of background text in SIMPROCESS: static text and dynamic labels. Static text is used for annotating the model layout and does not change during simulation. Dynamic labels are updated during simulation and are used to display information about changing properties of model elements. Several text labels can be grouped together on the layout and their horizontal and vertical alignment can be set using the **Align** option.

Dynamic labels can be updated automatically or by using the SIMPROCESS Expression Language. The SIMPROCESS Expression Language is an advanced feature found in SIMPROCESS Professional. Updating dynamic labels using expressions is covered in "Customizing a Model with Attributes and Expressions"

Properties are specified in the **Background Text** dialog, invoked by selecting a text tool from the Model Toolbar (marked by a capital T) and clicking on the background in the location where text is to be placed. Text can be moved by clicking and dragging. The following shows a static label. Note that the **Static Label** field and **Font Attributes** are all that are required for a static label. Static text can have multiple lines of text and can be aligned **Left**, **Center**, or **Right**.



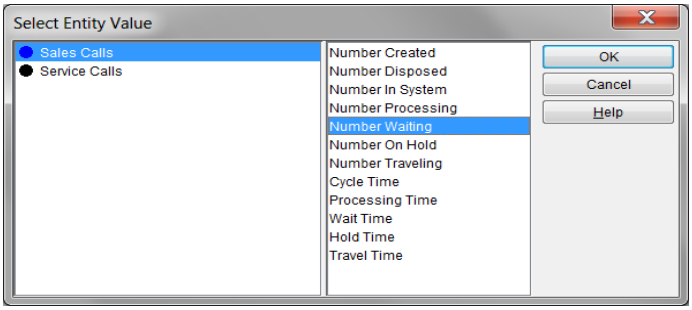
**Dynamic Label Properties,** is only applicable to dynamic text. **Font Attributes** is used to specify text properties for dynamic and static text. Defaults for the **Font Attributes** can be set on the **Background Text** tab of the Preferences dialog (**Edit/Preferences**).

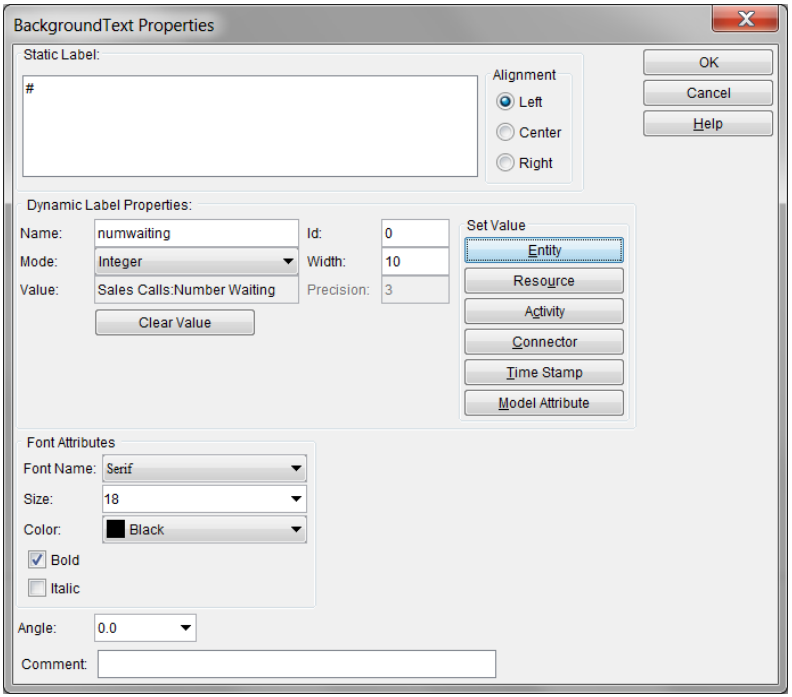
SIMPROCESS provides a list of the available fonts. Some fonts will not properly display their names in the combo box if the Java environment is unable to handle them. Avoid using these fonts. All rotation settings in the **Angle** combo box can be used with any font settings. Note that once the text is placed on the layout, the selection box around it has no handles. The only way to resize font text is to change its point size in the **Fonts** dialog. Once the text is placed on the layout, it can be moved, its properties edited, and it can be grouped with other objects on the layout.

When a dynamic label is placed on the layout, in addition to its font attributes, appropriate information needs to be entered in the **Dynamic Label Properties** group. Each dynamic label must have a unique combination of **Name** and **Id** number. Usually, **Id** number will be 0, unless two dynamic labels have the same name. The name typed into the **Name** text box will not appear on the layout. It will only be used to reference the label. Also, choose the type of value with which the dynamic label will be updated. The choice between String, Integer, and Real is made in the **Mode** combo box. If the value of the dynamic label is Real, also specify **Width** and **Precision** in the corresponding value boxes. **Width** is the total number of digits that will be shown for the displayed value (including the decimal point), while **Precision** specifies the number of digits after the decimal point that will be displayed. If the **Width** is greater than the value being displayed, it will be padded with spaces on the left side. If the **Mode** is Integer, then only the **Width** field needs to be set.

The **Value** field can be left empty. If so, the dynamic label can only be updated by using the SIMPROCESS Expression Language (see "For a list of System Methods available in SIMPROCESS, refer to "SIMPROCESS System Methods"."). Likewise, if the **Mode** is String, the dynamic label can only be updated through the SIMPROCESS Expression Language. If the **Value** field is not empty, the dynamic label will update automatically every time the selected value changes. The six buttons to the right (**Entity**, **Resource**, **Activity**, **Connector**, **Time Stamp**, and **Model Attribute**) are used to set the **Value** for the dynamic label. These buttons are active when a valid **Name** and **Id** has been entered and the **Mode** is not String. Each button brings up a dialog that lists each model element of that type (Entity, Resource, etc.) on the left. Once a value is selected on the left, the values available are listed on the right. Only one item can be selected on each side.

Selecting the **Entity** button displays the following dialog.




The **Value** field can be changed by selecting a different value using one of the six **Set Value** buttons. Select the **Clear Value** button to clear the **Value** field. As stated earlier, leaving the **Value** field empty means the dynamic label can only be updated using expressions.

Although it is not necessary, add a **Static Label** to the dynamic label definition. (The **Static Label** should be fully contained on one line.) If this is not done, there will be no place holder for the dynamic label on the layout after the dialog is closed. This label can still be found by dragging a rubber band box in the selection mode around the area where it was placed. A very small selection box may appear

at the location of the label. The label's properties can then be edited by choosing **Edit/Properties** off the menu. Also, adding a static label to the side of the dynamic label makes it simpler to find the dynamic label location and provides a description of the value being updated. The static label is not replaced when dynamic value is updated since they are two separate labels.

# Background Graphics

Select the Background Graphic icon from the Model Toolbar and move it to the layout to add a background graphic. The **Select Background** dialog will open. Backgrounds can be previewed before adding to the layout by selecting a background then clicking the **Preview** button. Choose the background, and select **OK** to close the dialog. Once the graphic is on the layout, it can be resized by selecting **Edit/Resize**. Note that background graphics cannot be resized using the resize handles.

The properties of the Background Graphic has two options on the properties dialog, **Locked** and **On Top**.

The **Locked** option locks the Background Graphic to its current position on the layout, preventing inadvertent moving of the Background Graphic while editing or navigating. Background Graphics default to unlocked.

Turning the **On Top** option on brings the Background Graphic to the front of the layout display. Typically this option is left off, so that the Processes, Activities, and Connectors on the screen will appear on top of the Background Graphic.

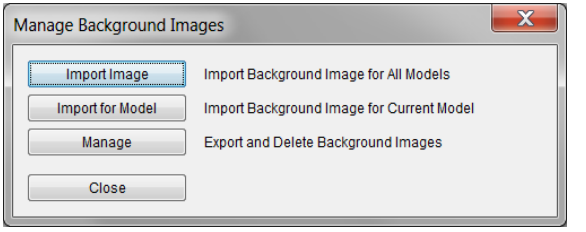
Note that Background Text added after a Background Graphic has been added to a layout will be behind the Background Graphic. If the Background Graphic is not transparent, the Background Text will not be visible. To solve this, make sure **Locked** is not selected, then select the Background Graphic and choose **Layout/Send to Back**.

# Importing Graphics Image Files

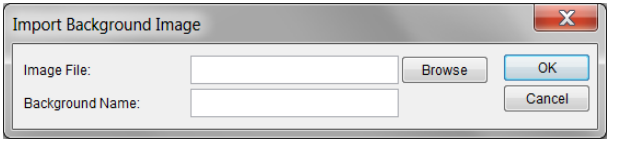
A Graphics Interchange Format (GIF), Joint Photographic Experts Group (JPEG), or Portable Network Graphics (PNG) graphic can be imported into SIMPROCESS. An imported graphic can be used as a Background Graphic, as an icon representing a Process or Activity, or as an icon representing an Entity.

## *Background Images*

To use an imported graphic as a background, select **Manage Background Images** from the **Tools** menu. This will open the **Manage Background Images** dialog. The dialog has two actions for importing background images: **Import Image** and **Import for Model**. **Import Image** imports a background graphic for use by any SIMPROCESS model. **Import for Model** imports a background graphic only for the currently active SIMPROCESS model. **Import for Model** is disabled if no model is open or the active model has not been saved and given a name.

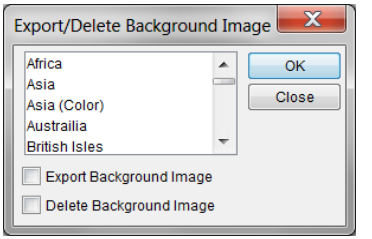



Selecting the **Import Image** or **Import for Model** buttons will open the **Import Background Image** dialog.




Select the **Browse** button, and choose a graphics file. Enter a name in the **Background Name** field. This is the name that will display in the list of available backgrounds and must be unique. Select **OK** to import the graphics file for use in SIMPROCESS.

Other features available from the **Manage Background Images** dialog can be accessed by selecting **Manage Images**, which opens the **Export or Delete Background Image** dialog.

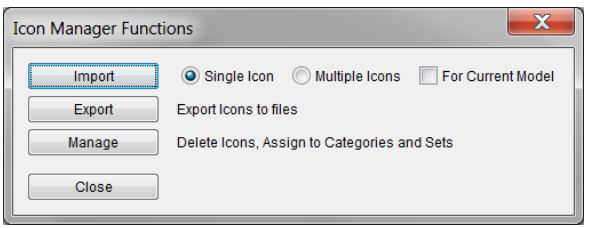



This dialog allows exporting any of the available backgrounds to external graphics files, including those provided with SIMPROCESS. In addition, it will allow deletion of any imported background images. Note that background graphics imported for the currently active model will have ** (a pair of asterisks) before the name.

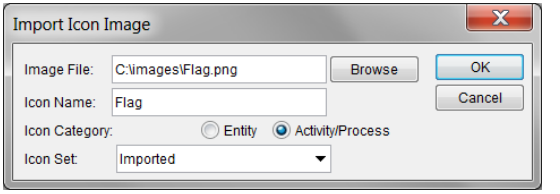
## *Activity, Process, and Entity Images*

Use the Icon Manager (**Tools/Icon Manager**) to import a graphics file for use as a Process, Activity, or Entity.

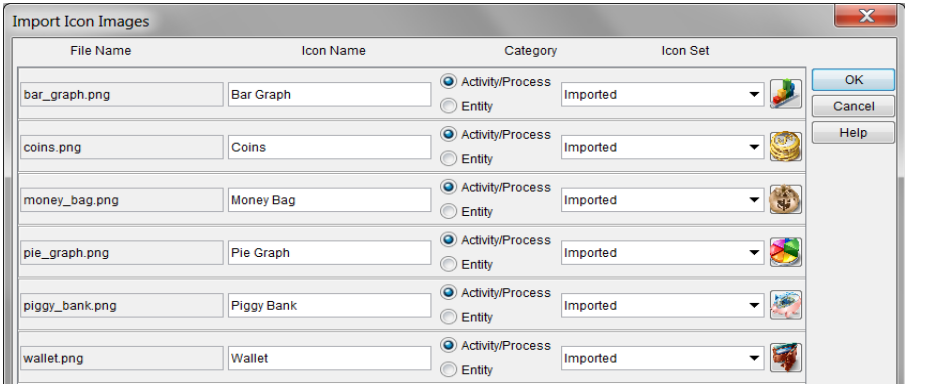
The **Icon Manager** is used to import, export, and manage image files. A single image file can be imported for use as an icon, or multiple files (such as a directory of image files) can be imported. Select **For Current Model** to have the import apply only to the currently active SIMPROCESS model. **For Current Model** will be disabled if no model is open or if the currently active model has not been saved and given a name.




Choose **Single Icon** and click **Import** to import a single image for use as an icon. Use the **Browse** button to locate the **Image File** to import. Once selected, enter the **Icon Name**, which must be unique among all icons no matter what category or set. Select the **Icon Category** and **Icon Set**. If the **Icon Set** needed is not listed, create a new set by typing it in the **Icon Set** field. Click **OK** to finish the import.




A directory of images can be imported by choosing **Multiple Icons** and clicking **Import**. Using the **Browse** button, select the directory that contains the images to import. Only directories will be listed in the file chooser. Files may not be selected. All `.gif`, `.jpg`, and `.png` files in the directory will be imported. The **Icon Name** for each will default to the name of the file minus the extension. These names can be changed as long as they remain unique among all the standard and imported icons. An error message will appear listing the names that are not unique.

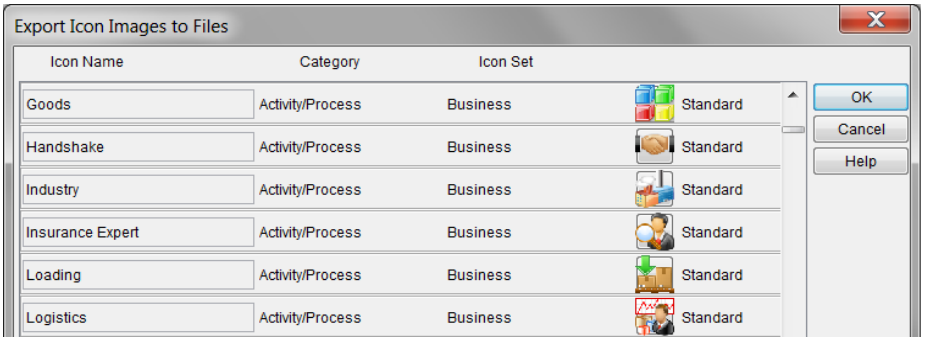



## Note

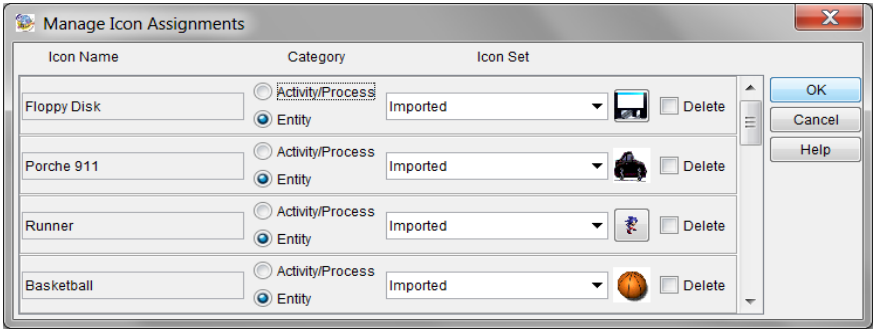
Copies of imported graphics are placed by SIMPROCESS in the `UserFiles.jar` file located in the SIMPROCESS working directory (see "SIMPROCESS Working Directory"). If the graphic is imported for the currently active model, a copy of the graphic is placed in the `ModelImages.jar` file located in the model's directory

**Export** exports images to a directory. It lists all the icons in SIMPROCESS, whether standard to SIMPROCESS or imported. The export dialog will list the **Icon Name**, **Category**, **Icon Set**, and whether the icon is **Standard**, **Imported**, or **Model**. (**Standard** indicates the icon was included as part of the

SIMPROCESS installation. **Imported** means the icon was imported for use by any SIMPROCESS model. **Model** signifies the icon was imported for use by the currently active SIMPROCESS model.) Simply select the **Export** check box next to the icons to export and click **OK**. Using the **Browse** button, select the directory for the exported images.

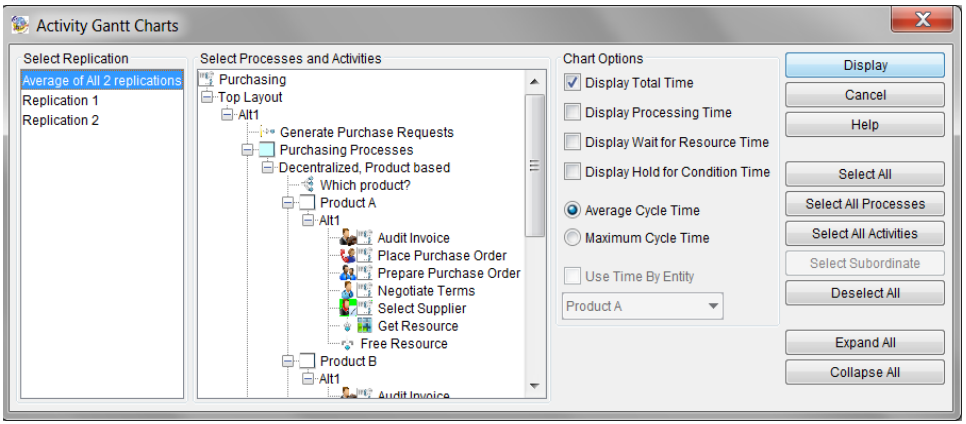



**Manage** brings up a dialog that lists the imported icons. This dialog changes the **Icon Name**, **Category**, **Icon Set**, or **Deletes** the icon. Icons that were imported for the currently active model will have ** (a pair of asterisks) before the name.



# Activity Gantt Chart

Gantt charts of the Activities and Processes in a model can be created after a simulation completes. This **Report** menu option is available if **Collect Activity Statistics** or **Collect Activity by Entity Statistics** is selected in **Define Global Statistics Collection** (see "Default Performance Measures" on page 243). Selecting **Activity Gantt Chart** displays a dialog containing a list of the replications, a tree view of the model, and various chart options.



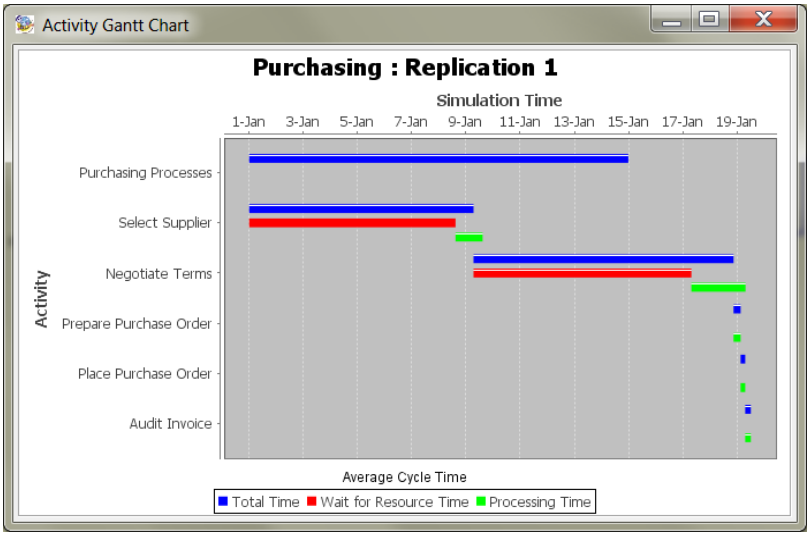

Note that **Sum of Replications** is not in the replication list. At least one replication must be selected, and a chart will be created for every selected replication. Select the Activities and Processes to include from the Activity/Process tree. Multiple items can be selected individually by pressing the Control key during selection. In addition there are buttons to assist in selection.

- **Select All** - Selects all Activities and Processes.
- **Select All Processes** - Selects all Processes.
- **Select All Activities** - Selects all Activities.
- **Select Subordinate** - This button is active when a single Process is selected. It selects all Activities and Processes subordinate to the selected Process.
- **Deselect All** - Removes all selections.

Just because an Activity or Process is selected in the tree does not mean that it will be included in the chart. Activities and Processes with zero cycle time will not be included.

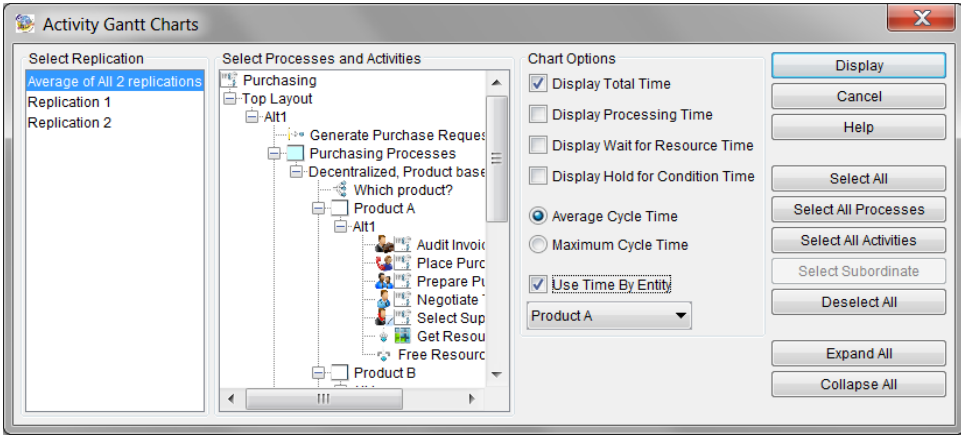
By default **Display Total Time** is selected. In addition to total cycle time, if an Activity has a specified delay time it will have **Processing** time, if an Activity requires Resources it most likely will have **Wait for Resource** time, and if an Activity queues Entities is will most likely have **Hold for Condition** time. Some Activities can have all three. There are options to include all three subsets of total cycle

time. These can be displayed without **Display Total Time** selected, but at least one time option must be selected. The example below shows **Wait for Resource** time and **Processing** time. (No Activities have **Hold for Condition** time.)

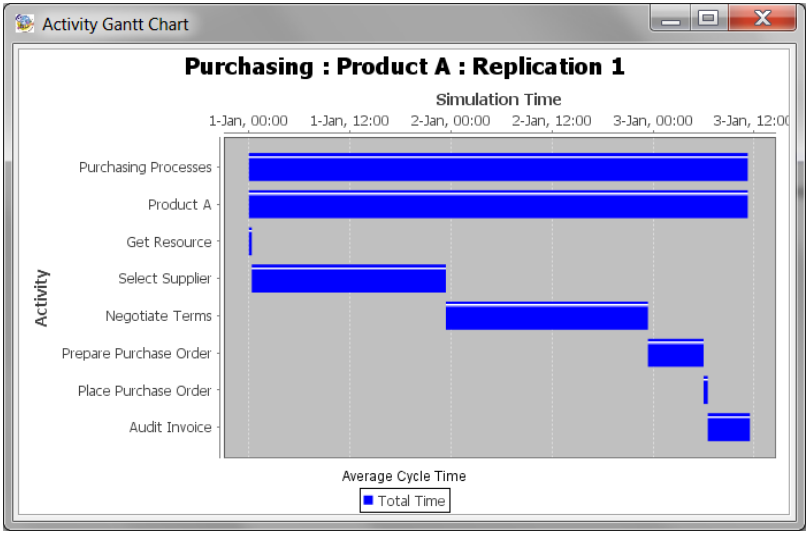



**Average Cycle Time** or **Maximum Cycle Time** can be used to create the chart. If **Average of Replications** is selected and **Maximum Cycle Time** is selected the maximum value will be the maximum of the replication averages.

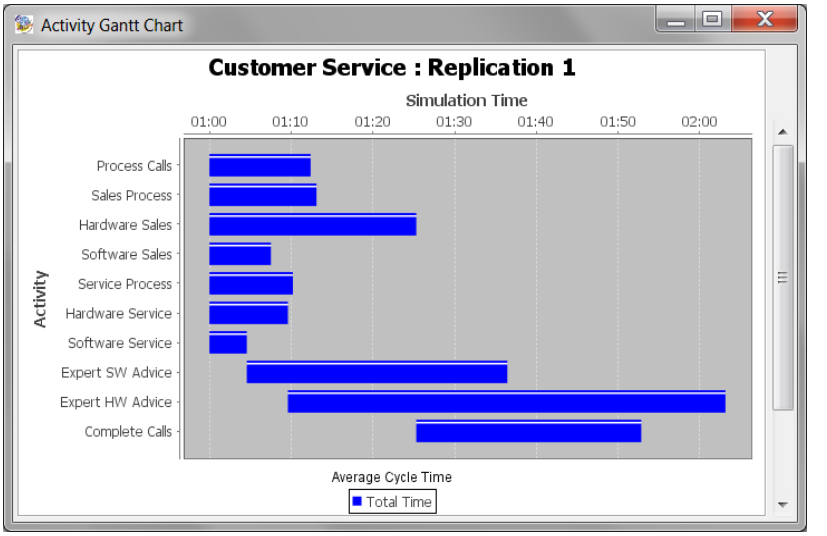
If **Collect Activity by Entity Statistics** is selected in **Define Global Statistics Collection** before the simulation run, **Use Time By Entity** will be active. If **Use Time By Entity** is selected the list of Entities will be active. The Activities in the chart will be the Activities from the selected Activities in the tree that have cycle time for the selected Entity.




The chart below, from the **Purchasing** demonstration model, displays only times for the Entity **Product A** (running with the **Decentralized, Product based** alternative active).




If there are more than 10 Activities and Processes on the chart a scroll bar will display on the right. Use the scroll bar to view the items not displayed. The Simulation Time axis at the top of the chart will adjust as other items are viewed. Below is a chart of the **Customer Service** demonstration model that includes all Activities and Processes. Note the scroll bar on the right.

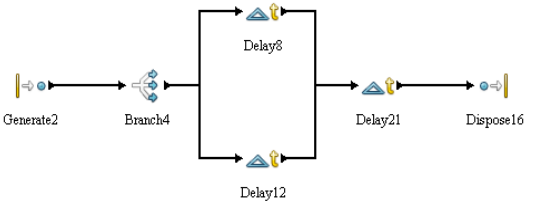



## *Gantt Chart Logic*

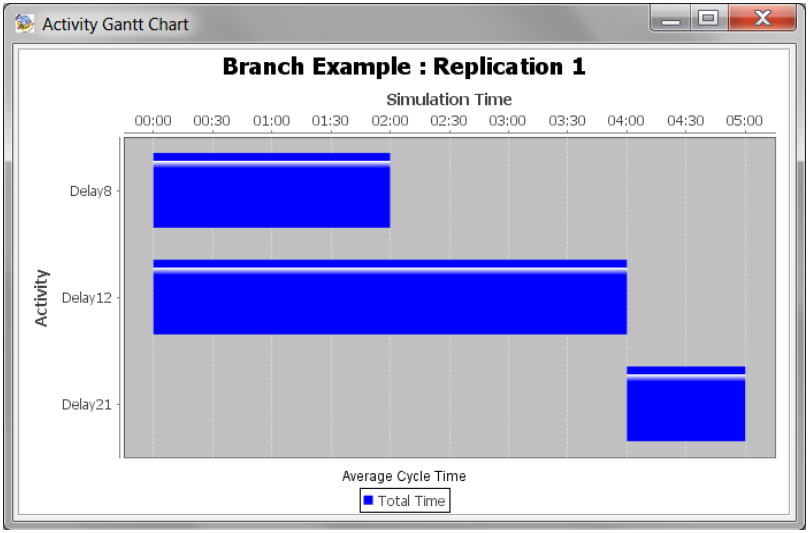
SIMPROCESS uses the following logic to create a Gantt chart.

- An Activity or Process that does not have a preceding Activity or Process is considered to be the first Activity or Process in an Activity/Process sequence flow. For example, every Generate Activity marks the start of at least one sequence flow.
- The starting time for all sequence flows is the starting date and time of the model.
- The sequencing of Activities and Processes uses the total cycle time for each Activity and Process.
- All sequence flows include every Activity and Process but only the Activities and Processes selected in the tree will be displayed in the chart. This means there can be gaps in the chart if all Activities are not selected.
- Loops within sequence flows are ignored.
- Connector delay times are not included.
- Duplicate Activity or Process names will have the name of the immediate parent Process in parentheses after the name. If there are duplicates of this combination the chart will only contain the last Activity/parent Process combination.

- When Activities or Processes are in parallel (such as Activities following a Split Activity) or are in an "exclusive or" arrangement (such as Activities following a Branch Activity) and the flow rejoins into a single flow, the first Activity or Process with cycle time will start at the time the Activity or Process with the longest cycle time in the parallel scenario ends. Consider the simple flow below.

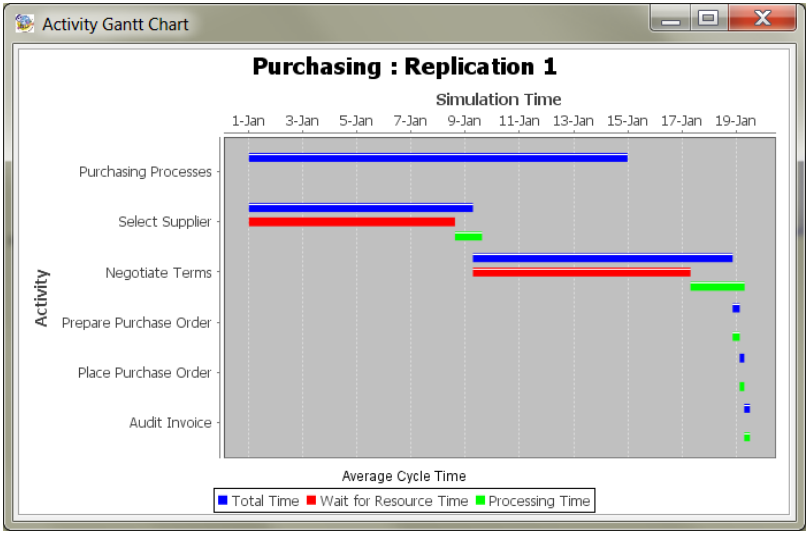



Delay8 has duration of 2 hours and Delay12 has duration of 4 hours. Thus, in the Gantt chart, Delay21 will begin after Delay12 since Delay12 has the longer duration.

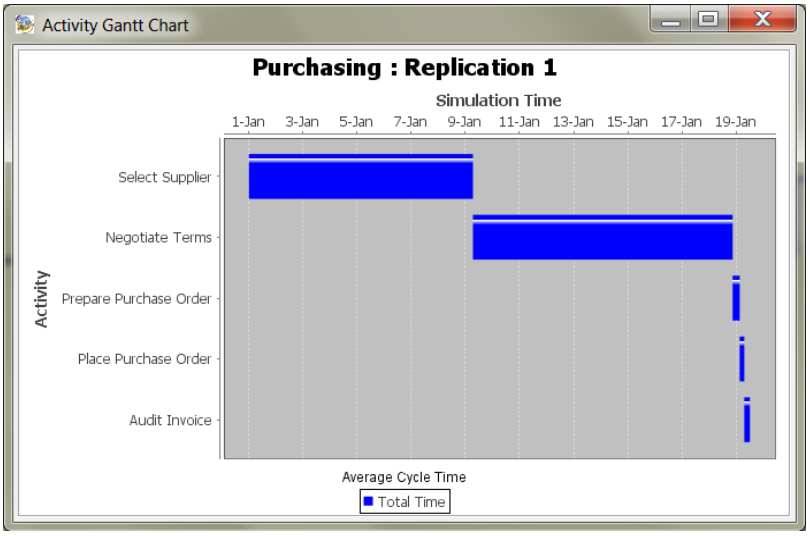



## *Gantt Chart Interpretation*

Activity Gantt Charts need to be interpreted carefully. In general the flow and duration of the model is seen in a chart. However, there can appear to be inconsistencies. Consider the chart from the Purchasing demonstration model displayed earlier with the breakout of the cycle times.



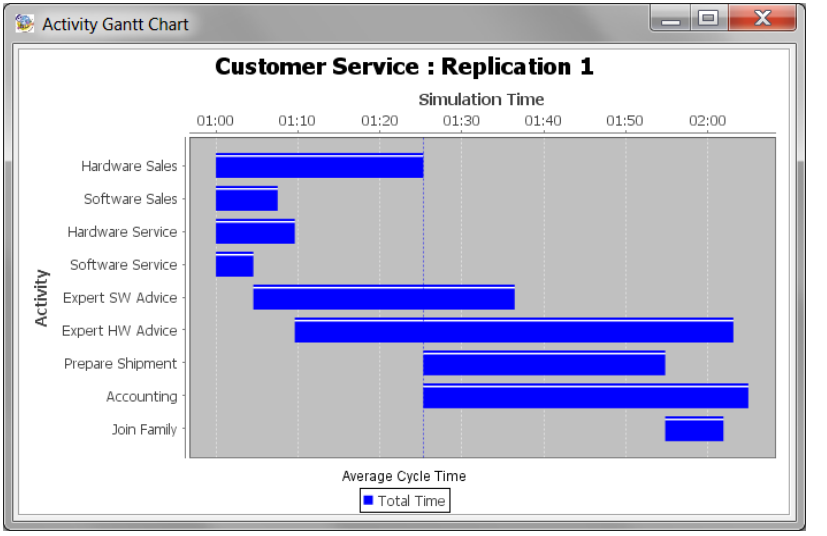

This chart shows the Process **Purchasing Processes** and every child Activity. Note that the total cycle time for the process is less than the ending time for the last Activity (**Audit Invoice**). This is because the overall average cycle time for the Process is less than the sum of the average cycle times for each Activity in the Process. This is due to the fact that there when the simulation ended more Entities had entered the Process than exited the Process, and the overall cycle time for the Process is not calculated until an Entity exits a Process. Also, note that the processing time for some of the Activities extends past the overall cycle time for the Activity. Again, this is due to the fact that there are different number of Entities for calculating the average Wait for Resource time and the average Processing time. (However, this chart does clearly show that the vast majority of the total time for **Select Supplier** and **Negotiate Terms** is time spent waiting for Resources.) These types of inconsistencies can be avoided by either only displaying Processes or Activities and by only displaying the total cycle time. See below the same chart as above but only with Activities and only displaying total cycle time.




The Activity Gantt Chart is most useful for models that have basically a sequential flow. If there are multiple loops or cross flows between Processes the Gantt chart can be more difficult to interpret. Potential issues include separation between sequential Activities and Activities being out of order.

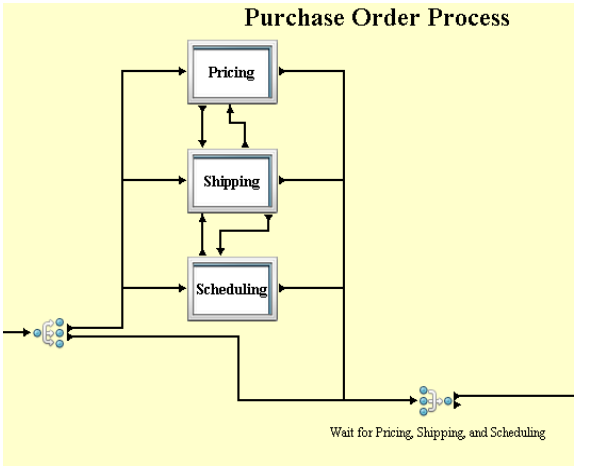
### *Sequential Activity Separation*

There may be separations between sequential Activities. The chart below is a chart of only the Activities of the **Customer Service** demonstration model. **Hardware Sales** and **Software Sales** are both Activities in **Sales Process**, which is within **Process Calls**. The Activities that follow **Process Calls** are **Prepare Shipment** and **Accounting** (both in **Complete Calls**). Clicking towards the end of a bar displays a blue dashed line at the time of the completion of that Activity. Note the blue dashed line that corresponds to the end of **Hardware Sales**. Following that line down the chart we see that both **Prepare Shipment** and **Accounting** start at the time that **Hardware Sales** ends. (Remember **Hardware Sales** and **Software Sales** follow the same Branch Activity so the following Activities begin at the end of the preceding Activity with the longest duration.)



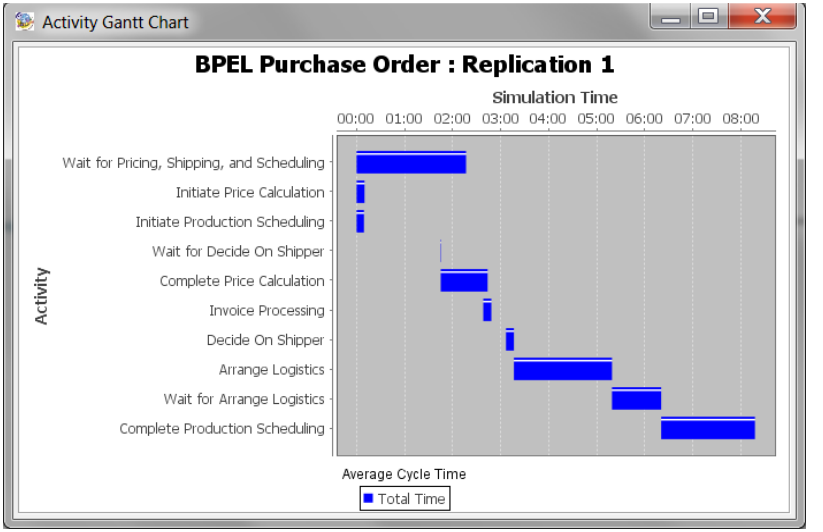

### *Activity Order*

There may be times when an Activity in a Gantt chart is shown to precede in time Activities that actually precede the Activity. Below is a view of the Purchase Order Process of the BPEL Purchase Order demonstration model.




Note that the Join Activity **Wait for Pricing, Shipping, and Scheduling** follows three parallel Processes. However, since there is a connector directly from the Split Activity to the Join Activity,

the Gantt chart displays the Join Activity at the same time as the first Activity in **Scheduling** (**Initiate Production Scheduling**) and the first Activity in **Pricing** (**Initiate Price Calculation**). Also, note that the first Activity in **Shipping** with cycle time (**Decide On Shipper**) shows a starting time later than the beginning of the simulation. This is because of the multiple incoming connectors to the flow within **Shipping**.




Selecting subsets of a model for display in a Gantt chart can reduce some of these issues. The bottom line, though, is Activity Gantt Charts can be quite useful but they must be used with care.

# Post Simulation Animation

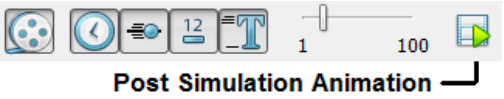
Animation is very useful in verifying and validating a model as well as communicating a model to management or customers. Normally, when turned on, animation displays while a model is simulating, which causes the simulation to slow significantly. In addition, only the animation for the current simulation time can be viewed. In other words, something in the past cannot be viewed again without restarting the simulation and waiting through the simulation to get to the point of interest.

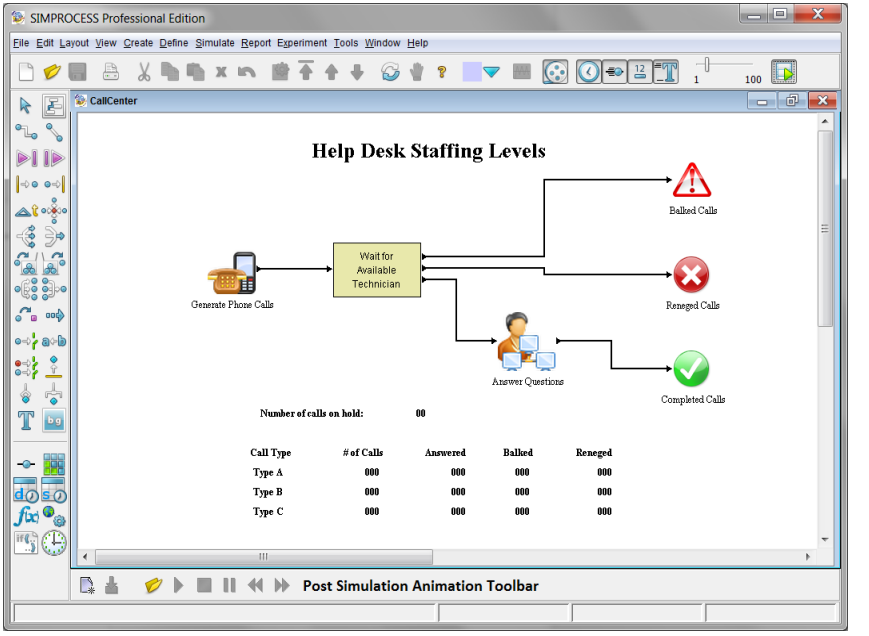
Post simulation animation displays an animation from a simulation without the simulation running. During a simulation the animation is recorded for playback. Animations can be recorded without displaying the animation during a simulation. Playback of animations that have been recorded can be paused, fast forwarded, and rewinded.

**Note**: Due to the addition of Connector delays and concurrent animation in SIMPROCESS Version 4.2, any animations that were recorded in a version prior to 4.2 will no longer replay. The animations must be recorded again.

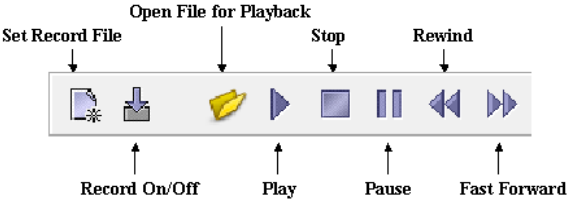
## *Post Simulation Animation Toolbar*

Post simulation recording and playback is controlled by the post simulation animation toolbar. The post simulation animation button displays and hides the post simulation animation toolbar. The button is to the right of the **Animation Speed** slider on the System Toolbar. The toolbar displays at the bottom of the SIMPROCESS layout.




SIMPROCESS Professional Edition
File Edit Layout View Create Define Simulate Report Experiment Tools Window Help
CallCenter
Help Desk Staffing Levels
Balked Calls
Wait for Available Technician
Generate Phone Calls
Reneged Calls
Answer Questions
Completed Calls
Number of calls on hold: 00
Call Type # of Calls Answered Balked Reneged
Type A 000 000 000 000
Type B 000 000 000 000
Type C 000 000 000 000
Post Simulation Animation Toolbar

The two buttons on the left are for recording, and the remainder are for playback.



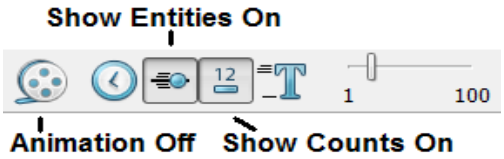

## *Recording an Animation*

Animation events are recorded in a file for playback. In order for the **Record On/Off** button to be active, an animation event file must be set using the **Set Record File** button. The **Set Record File** button brings up a dialog where the name of the file is entered. Do not enter the path to the file. Animation event files are automatically created in the model's directory. The file name is saved with the model. If an animation event file had been previously set, the **Record On/Off** button will activate when the toolbar is displayed.

The **Record On/Off** button is a toggle button. When the button is selected, animation events are recorded.

Thus, recording can be turned on and off multiple times during a simulation.

The animation option buttons on the System Toolbar, or the **Animation Settings** dialog (**Simulate/ Animation Settings** menu item) control which animation events are recorded. **Animation On**, **Show Clock**, and **Animation Speed** (slider) do not apply to recording animation events. The events recorded are determined by the status of **Show Entities**, **Show Counts**, and **Update Dynamic Labels**. If an item is selected, those type of animation events are recorded. In the example below, only the movement of entities and Activity counts would be recorded. Note that the **Animation On** button is not selected. Animation does not need to display during recording.




**Warning:** Animation events files can be very large. When recording counts and movement of entities, animation events for every level of the model must be recorded. Recording all that information will create very large files if recording is done for the whole simulation. The larger the model is, the larger the animation event file will be. Recording the movement of entities has the biggest impact. Recording only dynamic label events and/or Activity count events typically produces much smaller files.

## *Animation Playback*

An animation event file of an animation that has been recorded must be opened for playback. This is done using the **Open File** button on the post simulation animation toolbar.

**Important:** Make sure the animation event file opened was recorded from the currently active model. The file browser will automatically open to the directory of the model. If the model has changed since the animation event file was created, delete the previous animation event files and record again.

### *Play*

Once a file has been opened, the **Play** and **Fast Forward** buttons activate. Pressing **Play** will start the playback from the beginning of the animation event file.

### *Fast Forward*

Pressing **Fast Forward** brings up a dialog where an amount of time to skip is entered. Note that the value entered must correspond to the **Simulation Time Units** set in the **Run Settings.** (See "Setting the Simulation Time Unit" on page 108.) That time unit will display on the dialog. If **Fast Forward** is used before **Play**,

the time entered fast forwards the playback from the beginning of the simulation. Thus, if recording did not begin at the start of the simulation, it is possible that the time entered for **Fast Forward** will still be before recording began. So when **Play** is pressed, the playback begins where recording started.

### *Rewind*

**Rewind** is available once playback has started. Pressing **Rewind** brings up a dialog where the amount of time to back up is entered. This time must fall within the model's **Simulation Time Units**. The playback starts over at the beginning if the time entered goes past the beginning of the playback.

**Note:** Both **Fast Forward** and **Rewind** have an advantage over animation during simulation. During simulation, Activity counts and dynamic labels only update when an entity enters or leaves an Activity/ Process. So, when navigating through models during a run, there is normally a wait for counts and dynamic labels to display the most current values. A **Fast Forward** or **Rewind** during playback causes all counts and dynamic labels on the current level to immediately update to their values at that time.

### *Stop*

**Stop** ends the playback.

### *Pause*

When selected, the playback pauses. Press again to resume the playback.

### *Animation Controls*

The animation buttons on the System Toolbar control what is visible during a simulation animation, and they control what is visible during animation playback. Just like during simulation animation, disabling **Show Entities** will stop the display of the movement of entities. **Show Counts** and **Update Dynamic Labels** work similarly. Remember, the **Animation On** setting has no effect on animation playback. Also, these animation settings have no effect if those particular animation events were not recorded.

CHAPTER 7

# *Activity-Based Costing*

The purpose of this introduction to Activity-Based Costing (ABC) is to summarize its basic principles and describe the benefits of the integration provided with SIMPROCESS. A list of ABC references is provided in the back of the chapter for further reading.

The goal of ABC is to mimic the causal relationships among Resources, Activities, and Entities in assigning overhead costs. "The fundamental belief behind this costing approach is that cost is caused and causes of cost can be managed. The closer you can come to relating the costs to their causes, the more helpful your accounting information will be in guiding the management decisions of your business." states the *Ernst & Young Guide to Total Cost Management* (Ernst & Young, 1992).

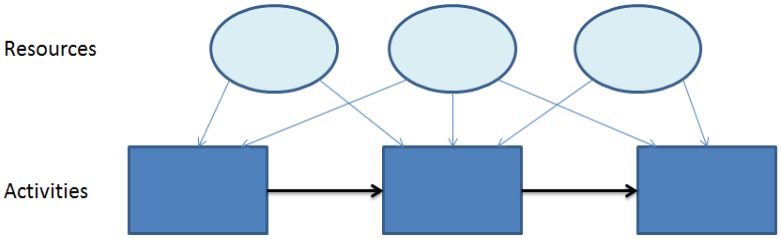
Enterprises use Resources to conduct activities. Resources perform activities to add value to products and services. The key to understanding cost dynamics in any enterprise is modeling the relationship between activities and their causes; and the relationship between activities and costs. If cost dynamics are not modeled (which is usually the case with traditional management accounting information systems), the performance information provided is incomplete or misleading.

# ABC and SIMPROCESS

Activity Based Costing is a technique for accumulating cost for a given cost object (i.e., product, service, customer) that represents the total and true economic Resources required or consumed by the object.

Activity Based Costing occurs in two phases. First, cost data is organized into Activity cost pools. In other words, the costs of significant activities are determined. This first phase is sometimes referred to as *Activity based Process costing*. Then, the amounts in the cost pools are assigned to products, services, or other cost objects. The second phase is referred to as *Activity based object costing.*

The architecture of SIMPROCESS provides an integrating framework for ABC. ABC embodies the concept that a business is a series of inter-related Processes, and that these Processes consist of activities that convert inputs to outputs. The modeling approach in SIMPROCESS manifests this concept and builds on it by organizing and analyzing cost information on an Activity basis.




One of the major challenges in successful implementation of ABC is finding the appropriate level of detail for the business Process analysis. The organization of business Processes is critical to reorganizing the cost data into Activity pools. The hierarchical modeling approach of SIMPROCESS facilitates this organization and accommodates varying levels of detail for ABC analysis. Another significant value of the ABC analysis in SIMPROCESS comes from the dynamic analysis of costs based on the event-driven simulation. Because SIMPROCESS tracks Resource interdependencies and captures the random nature of Processes, the cost statistics provided by SIMPROCESS are far more accurate than results obtained from static analysis.

# Benefits of ABC with SIMPROCESS

## *Focus on Cost Drivers*

One of the most important benefits of ABC is the focus it provides for estimating the key causes of costs. Executives can use these estimates to prioritize and monitor improvement efforts. For example, understanding the cost of poor quality can justify the investment in a quality program. Likewise, understanding the cost of complex or diverse products and services can help streamline the product and service offerings.

## *Strategic Pricing*

Life cycles of product and services are becoming shorter and shorter. The up-front costs of developing, testing, and marketing are not recouped until revenue is generated. Understanding the cost trade-off between life cycle stages is critical to strategically pricing the products, i.e., understanding when the total investment in product development can be recouped is valuable information for strategic pricing. ABC with SIMPROCESS allows simulation of the Process changes during the life cycle of a product/service for strategic or time-based pricing.

## *Evaluation of Capital Investments*

Reengineering business Processes requires a trade-off between the benefits and costs of making Process improvement changes. Without the trade-off, executives and managers are faced with making large investment decisions based on gut feel.

# How to Use ABC in SIMPROCESS

To get Process cost information from a SIMPROCESS model, first define the costs of the model's Resources and the cost periods to be analyzed. SIMPROCESS will distribute these costs to activities and to Entities as the simulation proceeds and provide extensive reporting of the results based on user-specified cost reporting periods.

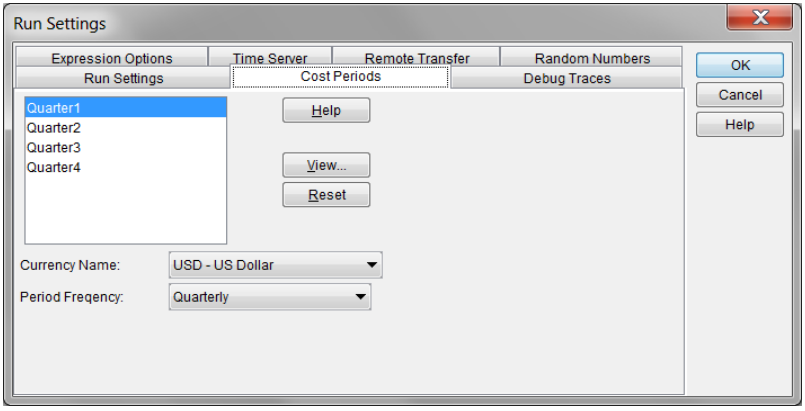
In order to provide a comprehensive cost analysis, SIMPROCESS differentiates between fixed costs and several types of variable costs that can be assigned to a Resource. SIMPROCESS allows multiple cost periods to be analyzed simultaneously and allows model level definition of costing periods. These features help to bridge the gap between an accountant's view and a manager's view of a business Process, provide an effective communication vehicle for the participants in a Process reengineering project, and make SIMPROCESS a complete business Process analysis tool.

SIMPROCESS' costing facility is very simple to use. Prior to running a simulation, define the cost periods for cost calculation purposes or accept the default cost periods, which are based on calendar quarters. Also, define costs for at least some of the Resources in the model, presumably those that represent the most significant costs in the business Process (hourly payroll, salaries, capital equipment depreciation, etc.). The following describes how to complete these two steps.

## *Setting Up Cost Periods*

Pick the cost periods that are most suitable for the system under study. SIMPROCESS selects **Quarterly** cost periods as the default but also allows **Weekly**, **Monthly**, **Half Yearly**, and **Yearly** cost periods. The following example demonstrates how to set cost periods for the default run length.

Select **Simulation/Run Settings** from the main menu. Then, click on the **Cost Periods** tab. This will display the **Cost Periods** definition tab as shown below.



The list in the upper left of this dialog shows the currently defined cost periods. The default periods for a one year simulation are Quarter1, Quarter2, Quarter3, and Quarter4. At the bottom of the dialog, is the **Period Frequency** selection list with the default *Quarterly* selected. Click the down arrow button to see all of the **Period Frequencies** that SIMPROCESS offers: **Weekly**, **Monthly**, **Quarterly**, **Half Yearly**, and **Yearly**. Notice that if a new **Period Frequency** is selected, SIMPROCESS will create a new set of periods in the period list and assign each a default name (Month1, Month2,..., or Week1, Week2,...). Notice also that SIMPROCESS will automatically create and name enough cost periods to span the currently specified run length. (The simulation **Start Time** and **End Time** are set from the **Run Settings** tab.)

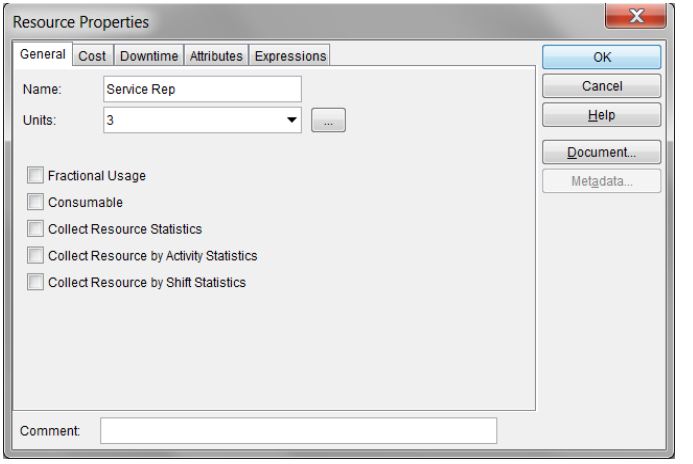
This dialog also sets the name of the **Currency** used on the cost reports. This is a simple label used in the reports. SIMPROCESS provides no currency conversion facilities and assumes that all cost amounts are in the same currency (e.g., Dollars or Euros).

When a particular cost period is selected and the **View...** button is clicked, SIMPROCESS will display the **Cost Period** detail dialog which shows the start and end dates and times for the cost period and the name of the period. The name of each cost period can be changed to be more descriptive in the context of the cost report. For example, the cost periods could be called Spring, Summer, Fall, and Winter rather than Quarter1, Quarter2, etc. Click the **OK** button to alter the cost period name or the **Cancel** button to discard any changes.

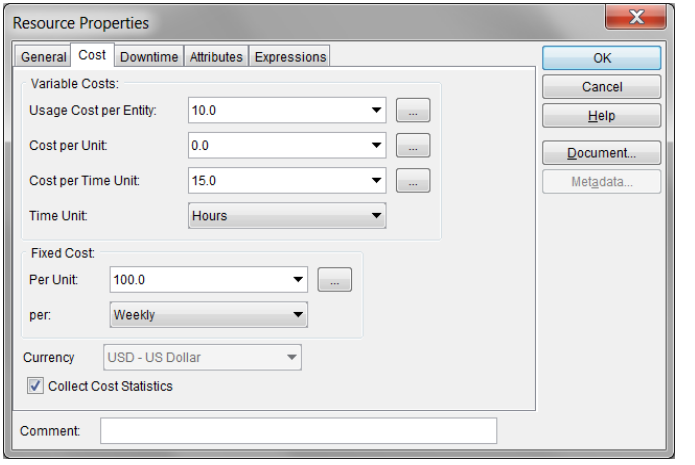
## *Setting Up Resource Costs*

Costs can be specified for each Resource in the model. All Resources do not have to have costs specified. SIMPROCESS will generate cost reports only for those Resources that have costs assigned. Both fixed and variable costs can be assigned to non-consumable Resources, and two of the three variable costs can be assigned to consumable Resources. These costs are specified as part of defining each Resource.

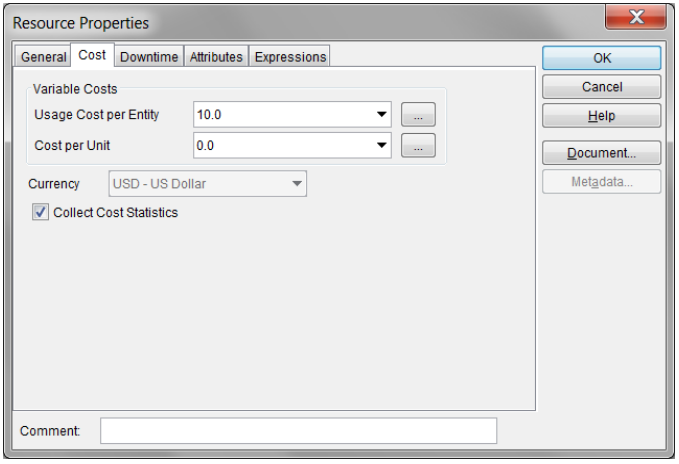
Select the **Define/Resource** option from the menu bar. Then pick a previously defined Resource from the list for editing or add a new one using the **Edit** or **Add** buttons. This will display the **Resource Properties** dialog as shown below:




Click the **Cost** tab to display the **Resource Costs** for this Resource. Since the Resource is nonconsumable, all **Variable Costs** and the **Fixed Cost** are included.




The box at the top shows the **Variable Costs,** and the box below shows the **Fixed Cost**. Below is the **Cost** tab for a consumable Resource.




The check box at the bottom left-hand corner of the dialog, **Collect Cost Statistics**, is turned on by default whenever cost information is entered. Leave this selected. Otherwise, cost statistics will not be gathered.

### *Variable Costs*

Three types of variable costs can be specified for non-consumable Resources:

- **Usage Cost per Entity** - This cost is applied to each Entity that is processed by the Resource. It is used to represent "flat fee" charging schemes. The same cost is assigned regardless of the amount of the Resource's units that is used or the duration of the Activity. Example: Often administrative charges or service call charges are based on this kind of charging scheme.
- **Cost Per Unit** - This cost is applied to each Entity that is Processed based only on the amount of the Resource's capacity that is used to Process the Entity. The cost is not calculated based on the time that the Activity takes to complete. Example: Fuel may be defined as a consumable Resource and cost per unit may be $2.50 per gallon. Every time a gallon of fuel is consumed, it will cost $2.50.
- **Cost per Time Unit** - This cost is calculated based on the amount of Resource capacity used and the time used. Example: Machine rental charges or hourly salary paid to employees are a common example of this type of cost.
- **Time Unit** that applies to the **Cost per Time Unit**. Defaults to **Hours**.

### *Fixed Cost*

**Fixed Cost** is defined in the box below the **Variable Costs** box. Enter the fixed cost amount in the **Per Unit** value box, and select the time basis for the cost from the selection list below. Machine depreciation

or fixed salaries are common examples of this type of cost. To specify the fully burdened cost of a set of salaried employees represented by this Resource, and the cost per employee is $50,000 per year, enter 50000 in the **Per Unit** box, and select **Yearly** from the list below. Click the down arrow to the right of the list to see the available items. The list contains the same time intervals that are available for the **Cost Period Frequency**. These do not have to be the same in both places. SIMPROCESS will perform all the necessary conversions automatically.

For example, annual salaries can be specified and the simulation run with weekly cost periods. SIMPROCESS will convert the annual salary costs to weekly costs when generating the cost data. After a simulation is completed, reports of the costs are available. The total cost and the cost by period can be seen by choosing **Display Standard Report** from the **Reports** menu. These costs are divided into three categories: **Resource by Activity**, **Resource by Entity**, and **Activity by Entity**. If there are Resources from OrgModels that have costs assigned, there are two additional categories: **Org Node by Resource** and **Org Node Cumulative Costs**. See the *SIMPROCESS OrgModel Manual* for more information on OrgModels, OrgNodes, and Resources (SIMPROCESS Organization and Resource Models).

## Cost Calculations

When a simulation is run, SIMPROCESS pauses at the end of each cost period to calculate the period costs. SIMPROCESS tracks all the activities that used the Resource and all of the types of Entities processed. For each Resource that has costs specified and that is set to calculate costs, SIMPROCESS will distribute the Resource's fixed and variable costs for the period to all of the activities that made use of the Resource during the period. This distribution is based on the amount of the available capacity used by the Activity during the period. For example, suppose that a Resource is used evenly by two activities and was busy 50% of the time for the cost period. Further, suppose that during the period each Activity processed five Entities, two of type A and three of type B. SIMPROCESS will calculate the costs for this period as follows:

1. Calculate the variable costs for each Resource based on the number of Entities Processed and the processing times as described.
2. For each of the two Resources, calculate the portion of fixed cost represented by idle time. Then calculate both the fully absorbed and variable-based fixed costs. (In this case, the fully absorbed costs should be twice the variable costs, since the Resource was 50% idle during the period.)
3. Add the variable costs to the fully absorbed costs and the variable-based costs, creating two period costs for each Resource.
4. Divide the period costs for the Resource based on the usage by activities. (In this case, the period costs will be split evenly between the two activities.)

These steps are completed for all Resources in the model that are set to calculate costs. Each Activity accumulates its period costs from all of the Resources that it actually made use of during the period. Next,

SIMPROCESS will calculate the Entity costs based on these Activity costs. After all Resource costs are distributed to the activities, the Activity costs are then distributed to each type of Entity processed by the Activity, based on the total number of Entities processed. These calculations proceed as follows:

1. The Activity determines the total number of Entities processed for the period and the portion of this total represented by each type.
2. The Activity costs are apportioned to the Entities based on the number of each Entity type divided by the total number of Entities.

The pool of Activity cost is broken out to each Entity type based on the Entity usage of that Activity. The Activity cost is displayed in the cost report for the total number of each Entity type, not for each Entity instance. To calculate the Entity instance cost, divide the cost for that Entity type (the cost number displayed in the report) by the total number of Entities of that type processed (available in the Standard Report).

Upon completion of these calculations, SIMPROCESS resumes the simulation for the next cost period.

### Note

> Get Resource Activities accumulate the costs of Resources obtained at Get Resource Activities. This is because the Resource was not actually assigned to any of the activities where processing occurred.

## *References*

Michael R. Ostrenga, Terrence Ozan, Robert Mc Ilhattan, Marcus Harwood, *The Ernst & Young Guide to Total Cost Management*, John Wiley & Sons, New York, 1992.

Douglas Webster, *Activity Based Costing: A Tool for Reengineering the Enterprise*, Enterprise Reengineering, April/May 1995, pp. 18-23.

CHAPTER 8

# *Statistical Output Reports*

SIMPROCESS collects statistics by default for all Entities and all Resources. SIMPROCESS also allows the definition of custom statistics to gather more specific information about a model. The Entity and Resource statistics gathered will usually be sufficient when starting a model. As the focus of the analysis is sharpened and the model becomes detailed, custom statistics will be added to narrow in on the performance measures of most interest.

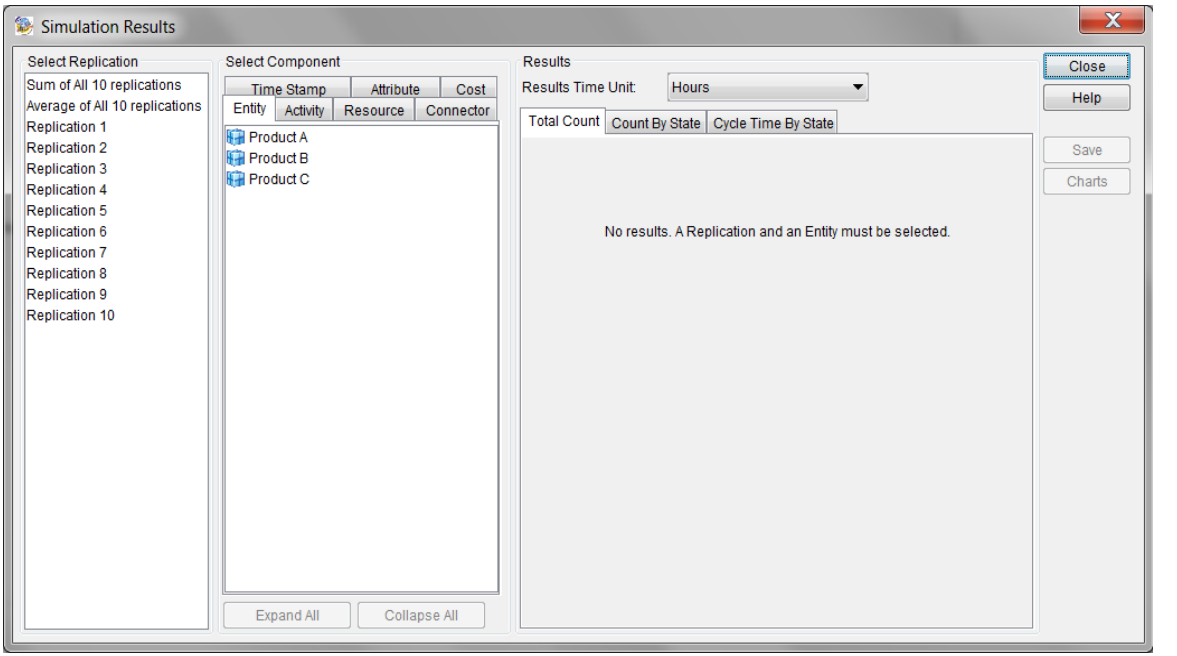
Simulation Results and the Standard Report offer a quick and complete view of the statistics collected during the simulation. Further, real-time plots (see "Real-Time Plots," beginning on page 259) and SIMPROCESS Dashboards (see "SIMPROCESS Dashboards") can be viewed, a Simulation Results file containing all the statistics gathered from the model can be exported in a tab-delimited format (see "Simulation Results File"), and results can be exported to a database (see "SIMPROCESS Database"). Custom Reports (see "Custom Reports") allow model definitions and simulation results to be combined into formal reports that can be viewed within SIMPROCESS and then saved in various formats. Scenario Reports compare results within or across Scenarios (see "Scenarios").

# Simulation Results

After the simulation run has completed, the statistical results of the simulation can be viewed. Statistics collected during the simulation can be viewed by selecting **View Simulation Results** from the **Report** menu or by right clicking on an item on the layout and choosing **View Results**. Results can also be saved to a file or viewed graphically.

## *View Simulation Results*

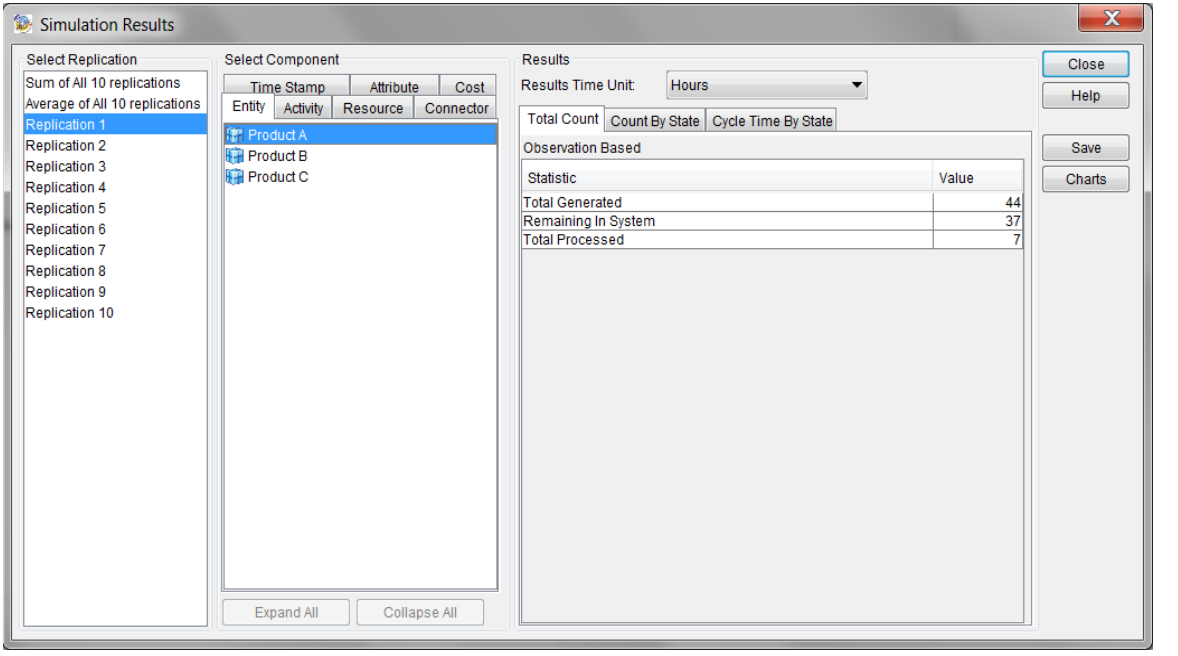
Selecting **View Simulation Results** opens the **Simulation Results** dialog.




The dialog consists of three sections: **Select Replication**, **Select Component**, and **Results**. The **Select Replication** section lists all the replications. If multiple replications were run options for the sum of all replications and average of all replications will be included in the list. The **Select Component** section contains a tab for each type of SIMPROCESS component for which statistics can be collected. The tabs are **Entity**, **Activity**, **Resource**, **Connector**, **Time Stamp**, **Attribute**, and **Cost**. The **Entity**, **Time Stamp**, and **Attribute** tabs will only contain items of the selected type for which statistics were collected. For example, if no Attributes had statistics collected then the **Attribute** tab will be empty. The Cost tab lists the cost categories **Resource By Activity**, **Resource By Entity**, and **Activity By Entity**. If one or more

OrgModels are assigned to the SIMPROCESS model, the cost categories **Org Node By Resource** and **Org Node Cumulative Cost** will also be listed. (See "Using OrgModels with SIMPROCESS" in the *SIMPROCESS OrgModel Manual* for information on using OrgModels with a SIMPROCESS model.) The **Activity**, **Resource**, and **Connector** tabs display tree views. Only the items needed for navigation and the items with statistics collected will be active.

When a replication from the **Select Replication** list and an item from one of the **Select Component** tabs have been selected, the statistics are displayed in the **Results** section. The tabs display the same statistical categories as the Standard Report and are described in Custom Statistics. When applicable the type of the statistics (Observation Based or Time Weighted) is displayed above the table of results.



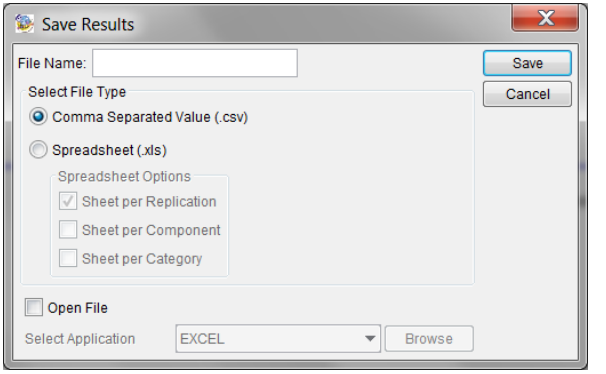

Observation based time statistics display in the time unit selected in **Results Time Unit**. Changing the selected time unit will update the statistics accordingly.

## *View Results*

Statistics for an individual Activity, Process, or Connector can be accessed directly by right clicking on the item and choosing **View Results** from the popup menu. **View Results** will only be active if statistics were collected for the selected item. As with **View Simulation Results**, the replications are listed. By default **Replication 1** is selected. The statistics are displayed in the tabs on the right.

## *Saving Results*

The **Save** button is enabled when one or more replications have been selected and one or more component items have been selected. (Multiple replications and multiple component items can be selected by pressing the Control or Shift key during selection.) The **Save** button displays a dialog with options for saving the selected results to a file.




A **File Name** without path must be entered (files are automatically saved to the model's directory). Based on the selection of **Comma Separated Value (.csv)** or **Spreadsheet (.xls)** the appropriate extension will be added to the **File Name**. There are three options for **Spreadsheet (.xls)**: **Sheet per Replication**, **Sheet per Component**, and **Sheet per Category**.

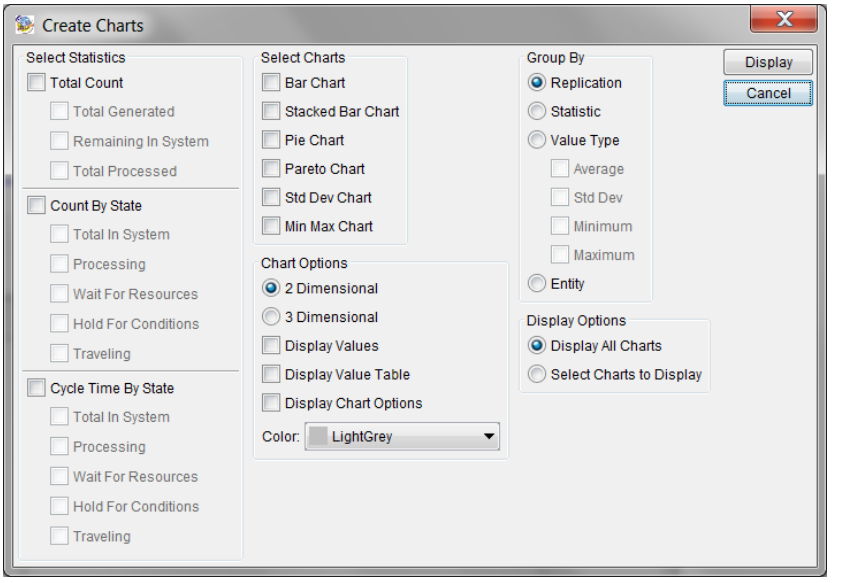
- **Sheet per Replication** - A separate sheet is created for each selected replication.
- **Sheet per Component** - A separate sheet is created for each selected component.
- **Sheet per Category** - A separate sheet is created for each statistic category. The statistics categories are determined by the type of component selected; therefore the sheets will correspond to the tabs displayed in the **Results** section

At least one of these options must be selected if **Spreadsheet (.xls)** is selected. The components for the Cost tab are the cost categories (Resource By Entity, Resource By Activity, etc.). Only the **Spreadsheet (.xls)** option is available if the cost categories **Org Node By Resource** and **Org Node Cumulative Cost** are available and either is selected.

Select **Open File** to have the file open by the application specified in **Select Application** once the save is complete. An error will occur if the location of the application stored in SIMPROCESS is invalid. If this happens, select the **Browse** button and locate the application's executable file.

## Results Charts

The **Charts** button is enabled when one or more replications have been selected and one or more component items have been selected. (Multiple replications and multiple component items can be selected by pressing the Control or Shift key during selection.) The exception to this is the **Cost** tab. The **Charts** button will be enabled only when one cost category is selected. The **Charts** button displays a dialog with options for graphically displaying the selected results. The options on the dialog depend on type of component selected. Below is the dialog for Entity results.




There are five sections: **Select Statistics**, **Select Charts**, **Chart Options**, **Group By**, and **Display Options**.

- **Select Statistics** - Lists the type of statistics available for the selected component type.
- **Select Charts** - Lists the type of charts available.
- **Chart Options** - Lists the options for how a chart displays.
- **Group By** - Lists the options for how the selected results will be displayed on a chart.
- **Display Options** - Lists the options for displaying charts.

### Select Statistics

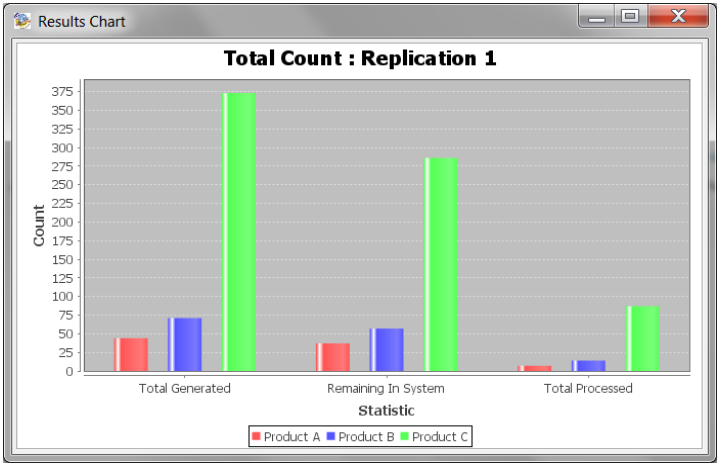
The statistics offered are the same as the statistics found on the Standard Report (see "Standard Report" on page 243). They are divided into the same categories. To select a specific statistic, the statistic category must be selected. This section is missing for Time Stamps and Attributes since there is only one statistic for each (**Cycle Time** for Time Stamps and **Value** for Attributes). The statistics are grouped

into categories since statistics from different categories cannot be charted together. For example the statistic categories for Entities are Total Count, Count By State, and Cycle Time By State. Total Count is an observation based statistic, Count By State is a time weighted statistic, and Cycle Time By State is an observation based statistic that has an associated time unit. Since the type of statistic is different (observation based versus time weighted) and the units are different (count, time weighted count, and time) it does not make sense to try to view statistics from different categories on the same chart. At least one statistic must be selected.

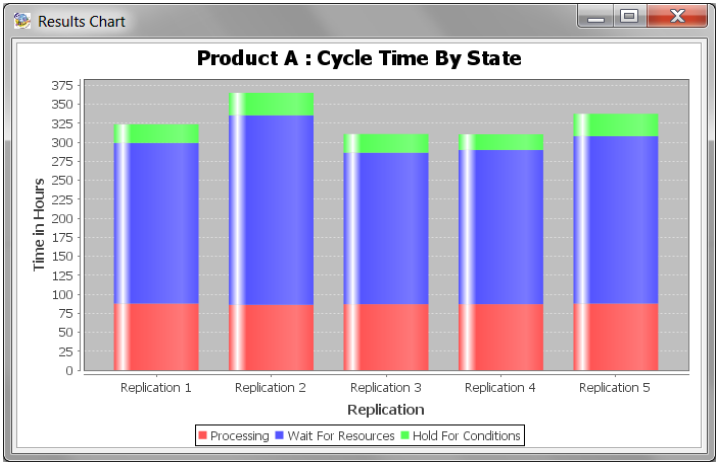
### *Select Charts*

Six types of charts are offered. At least one chart type must be selected.

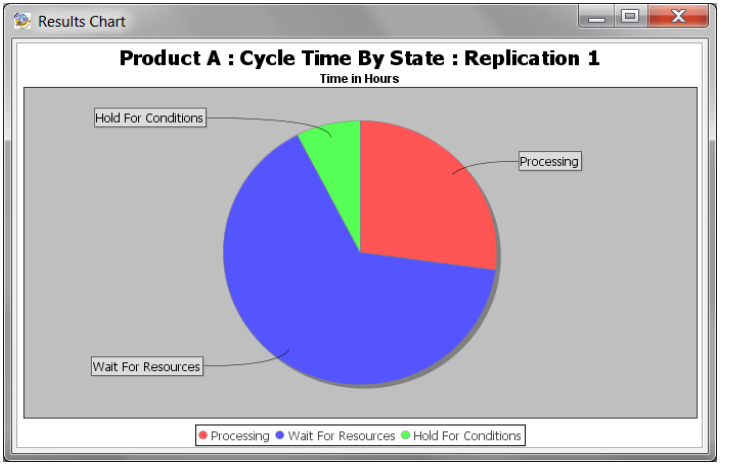
- **Bar Chart** - There is a bar for each value.



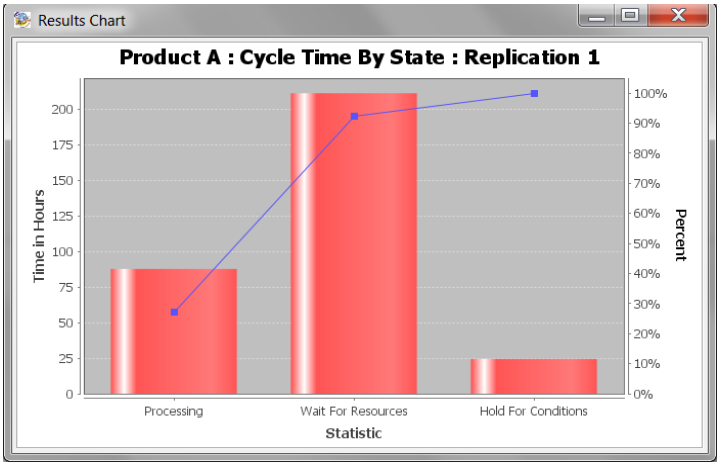

- **Stacked Bar Chart** - Values of the same type are displayed in the same bar. This chart assumes all the values of a bar are parts of a whole. (See the Pie chart example.)



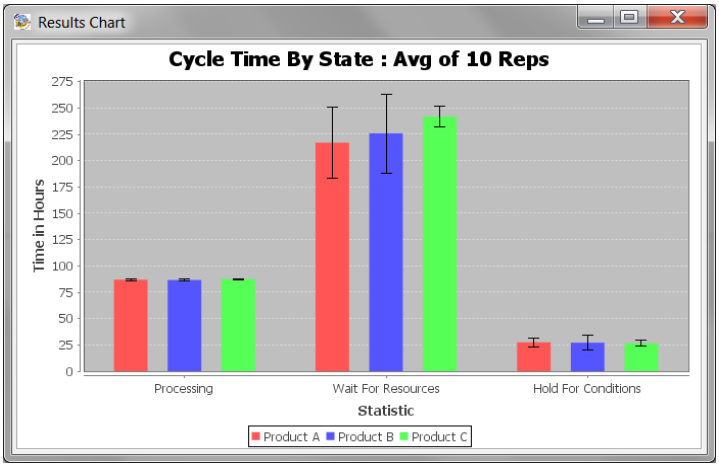

- **Pie Chart** - A section of the pie represents each value. This chart assumes all the displayed values are parts of a whole. Any "By State" statistics would apply here. For example the **Cycle Time By State** statistics **Processing**, **Wait for Resources**, **Hold for Conditions**, and **Traveling** sum to **Total In System**. Thus, if **Processing**, **Wait for Resource**, **Hold for Conditions**, and **Traveling** were displayed in a Pie chart each section would show how much each statistic contributes to **Total In System**.



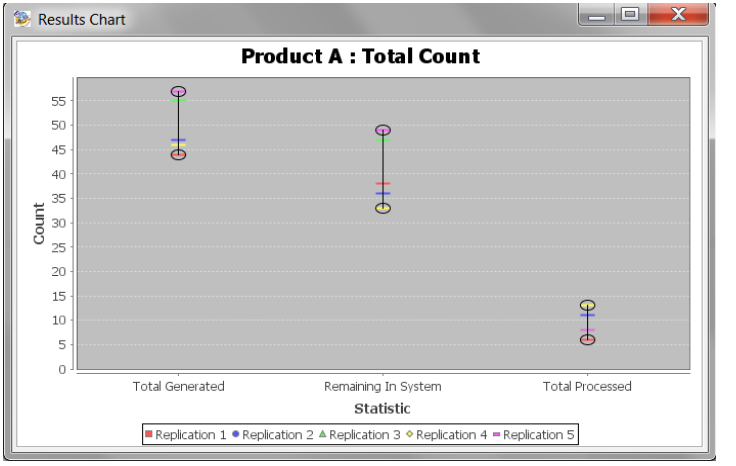

- **Pareto Chart** - Values are displayed as bars along with a line that plots the cumulative percentage each value is of the total. As with a Pie chart this chart assumes the charted values sum to a total value. The Pie chart example above would also apply to a Pareto chart.




- **Std Dev Chart** - The average value of each statistic is displayed as a bar along with a line over each bar that represents the standard deviation of the average. This chart is most helpful when the Average of Replications is selected but can be used for any statistic. Note that some statistics (like Total Count) will only have an average and standard deviation for Average of Replications.



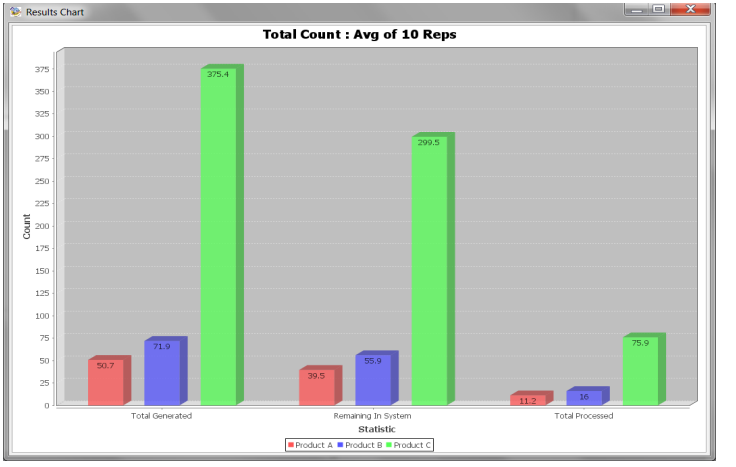

- **Min Max Chart** - Displays each result grouped appropriately with the minimum and maximum values circled.



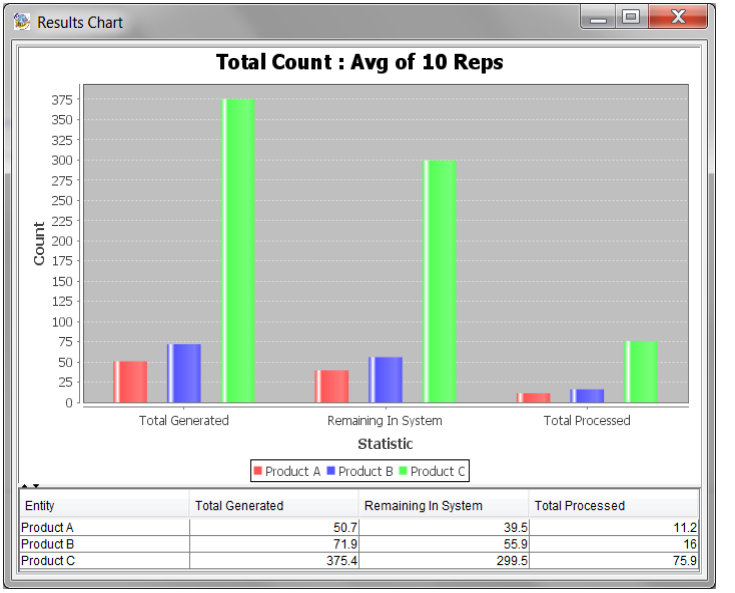

### *Chart Options*

Some options apply to some chart types and some options apply to all chart types.

- **Bar Charts**, **Stacked Bar Charts**, and **Pie Charts** can be **2 Dimensional** or **3 Dimensional**.
- **Display Values** applies to all chart types and displays the value of each item on a chart.

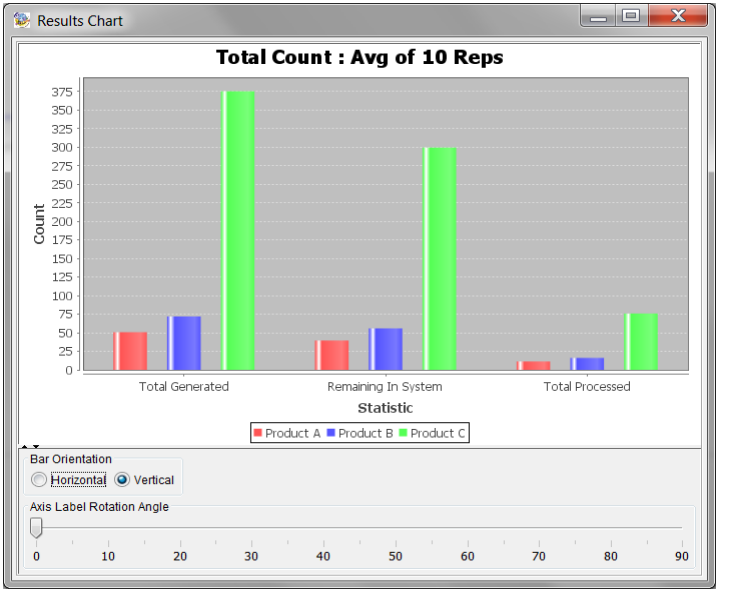



- **Display Value Table** also applies to all chart types. When selected this option displays a table of the chart values.

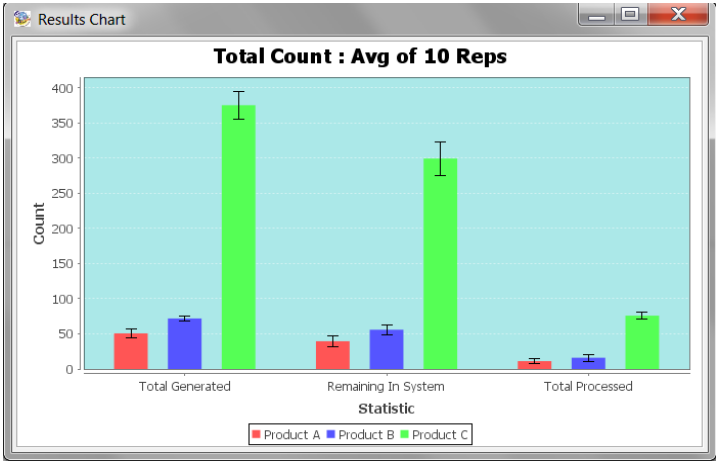



| Entity | Total Generated | Remaining In System | Total Processed |
|---|---|---|---|
| Product A | 50.7 | 39.5 | 11.2 |
| Product B | 71.9 | 55.9 | 16 |
| Product C | 375.4 | 299.5 | 75.9 |

- **Display Chart Options** displays options for all chart types except **Pie Chart**. The orientation can be set to **Horizontal** or **Vertical** and the axis labels can be set between zero and 90 degrees.

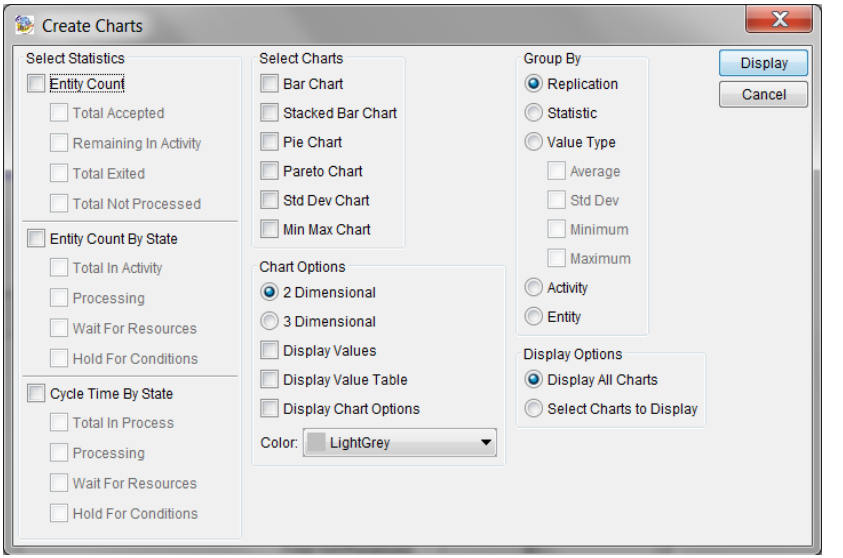


- Finally the **Color** of the background of all chart types can be set.




### *Group By*

The **Group By** options determine how the results will be grouped in the charts. To put it simply, whatever is selected as the **Group By** option will be the items in the Chart legend. So if **Replication** is selected as the Group By option, the legend will include whatever replications were selected (Replication 1, Replication 2, etc.). The results of all component types can be grouped by **Replication**, **Statistic**, and **Value Type**. When **Value Type** is selected the specific values to chart can be selected. Note that not all statistics will have all the value types. For example the Entity Total Count statistics only have **Maximum** for individual replications. If this type of statistic is selected, SIMPROCESS will produce an error message if **Display** is clicked and **Value Type** is selected and **Maximum** is not selected. Note that **Value Type** is not an option for **Std Dev Chart** and **Min Max Chart**. **When Available** is offered as a **Value Type** when the **Resource** tab is selected. This **Value Type** gives the same value as **Percent Utilization By State When Available** in the Standard Report. The remaining **Group By** options depend on the type of component selected. Each component has the option to group by the component type. For example if the **Activity** tab is selected there will be an **Activity Group By** option. There may also be other options. Again, if the **Activity** tab is selected and there are Activity by Entity statistics collected for at least one of the selected Activities, there will be an **Entity Group By** option. Since Resources can have statistics collected by Activity and by Shift, additional **Group By** options can include **Activity** and **Shift**. Below is the dialog for Activities when there are Activity by Entity statistics.




### *Display Options*

Each chart is displayed in its own frame. **Display All Charts** causes all charts created by the selected options to display. **Select Charts to Display** lists all the charts created by the selected options. Specific charts can then be selected to display. This option should be used if there is potential for many charts to be created.

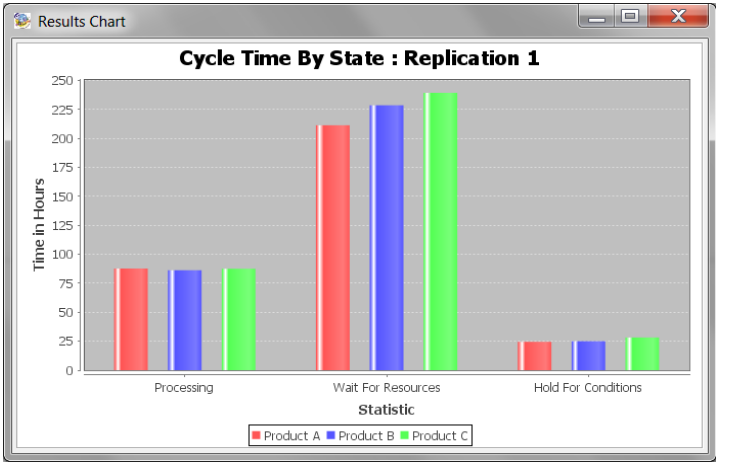
### *Charting Considerations*

Using the **Charts** function requires an understanding of the results selected for display.

The purpose of the various statistic types for each component must be understood. SIMPROCESS does not restrict what statistics can be displayed by each chart type. Just because a chart can display results does not mean the chart actually makes sense.

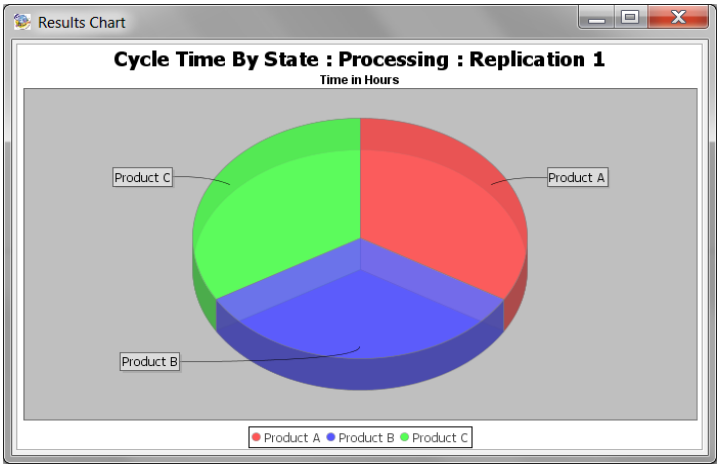
The dimensions of the results to display must be understood. For example at least one replication and one component must be selected in order to create a chart. Replication and component are two dimensions. The statistic categories of the selected statistics are a third dimension. Thus, there are at least three dimensions to the results. The chart types offered support one or two dimensions. Pie charts and Pareto charts display one dimension and the other chart types display two dimensions. Consider the bar chart below. Note that the legend has the name of the selected Entities. Thus, the **Group By** option was **Entity**. The title of the chart is **Cycle Time By State : Replication 1**. This means the statistics selected were from the **Cycle Time By State** statistic category and **Replication 1** was selected. The statistic dimension and replication dimension were combined so the two dimensions displayed by the chart

were Entity (component type) and the selected statistics from **Cycle Time By State** by replication. If two replications were selected (say Replication 1 and Replication 2), then two charts would be created. One chart would have the title **Cycle Time By State : Replication 1** and the other chart would have the title **Cycle Time By State : Replication 2**. If statistics from the statistic category **Count By State** were selected then there would be four charts created.

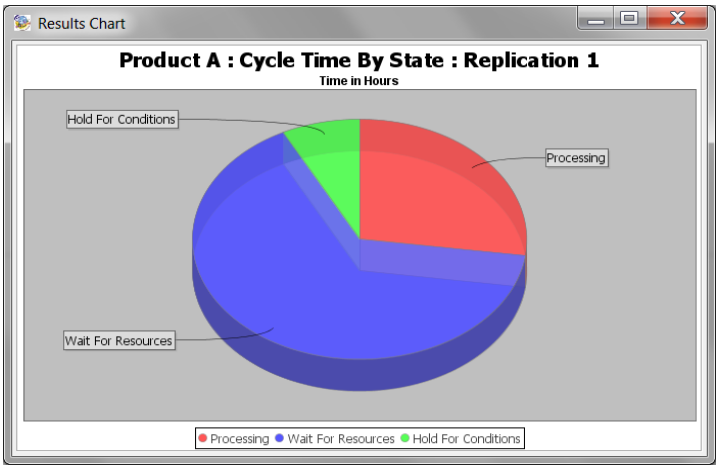



The **Group By** option also influences how many charts are created. Using the same selections as the above chart (**Replication 1**; the Entities **Product A**, **Product B**, and **Product C**; and **Cycle Time By State** statistics), if the **Group By** option is changed to **Replication**, three charts would be created. One dimension would be Replication (the legend) and the other dimension would be a combination of Entity and the statistics from the statistic category. Since three Entities were selected, there will be three charts. If another statistic category is used there will be six charts. Note, though, that selecting more replications will not result in more charts since the **Group By** option is **Replication**.

Pie and Pareto charts only support one dimension so, again if the same selections as above are used, three Pie or Pareto charts would be created instead of one Bar chart. The only dimension is a combination of all the selections. Since the Group By option was **Entity** and three statistics were selected there are three Charts. The titles are **Cycle Time By State : Processing : Replication 1**, **Cycle Time By State : Wait For Resources : Replication 1**, and **Cycle Time By State : Hold For Conditions : Replication 1**. The legend for each is the selected Entities. This first of the three charts is shown below.



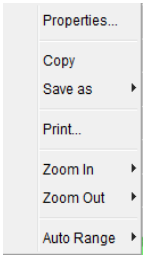

It would probably make more sense to select **Statistic** as the **Group By** option. When that is done there are three charts but each chart is for one Entity instead of for one statistic.




In summary, depending on what is selected, many charts may be created. Be thoughtful about the selections before clicking **Display**, especially if **Display All Charts** is selected. The only way to close all open charts at once is to exit SIMPROCESS.

### *Other Chart Options*

Right clicking on a chart displays the following menu




The **Properties...** item allows changes to the chart title, domain axis, range axis, and appearance.

**Copy** places the chart on the system clipboard.

**Save as** offers the option to save the chart as a PNG file.

**Print...** prints the chart. This can be used to save the chart to a PDF if that is a print option.

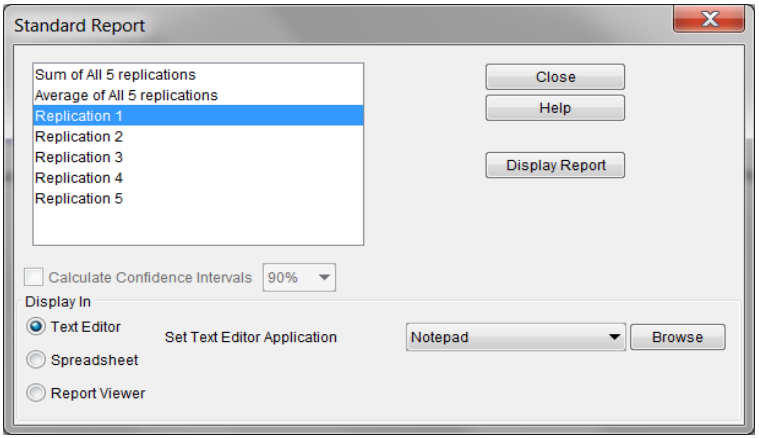
Zooming can be done on the Range axis and can be done with **Zoom In** and **Zoom Out**. The Range axis can also be zoomed by selecting and dragging over the range of interest with the mouse.

**Auto Range** restores the chart to its original view.

# Standard Report

After the simulation run has completed, the Standard Report can be displayed to view output statistics for the model. The Standard Report includes all statistics collected during the simulation. From the **Report** menu bar, choose **Display Standard Report**.

This will open the **Display Standard Report** dialog. In the **Report Replications** list box (if the model ran for multiple replications), an individual **Replication**, the **Average of All Replications**, or the **Sum of All Replications** can be selected. Typically, for runs of multiple replications the **Average of All Replications** report is most useful. **Calculate Confidence Intervals** is activated if the **Average of All Replications** report is selected. **Calculate Confidence Intervals** allows selection of 90%, 95%, or 99% confidence intervals for each performance measure. Next, select to view the Standard Report with a **Text Editor** (Notepad by default on Windows), with a **Spreadsheet**, or with the **Report Viewer** (see "Report Viewer"). Press the **Display Report** button to open the report.




To view the Standard Report with a spreadsheet, select **Spreadsheet**, then use the **Browse** button to point to its executable, i.e., `Excel.exe`. Once the spreadsheet is open, the Standard Report data is best viewed in the left justified mode and with **AutoFit** checked for the columns.

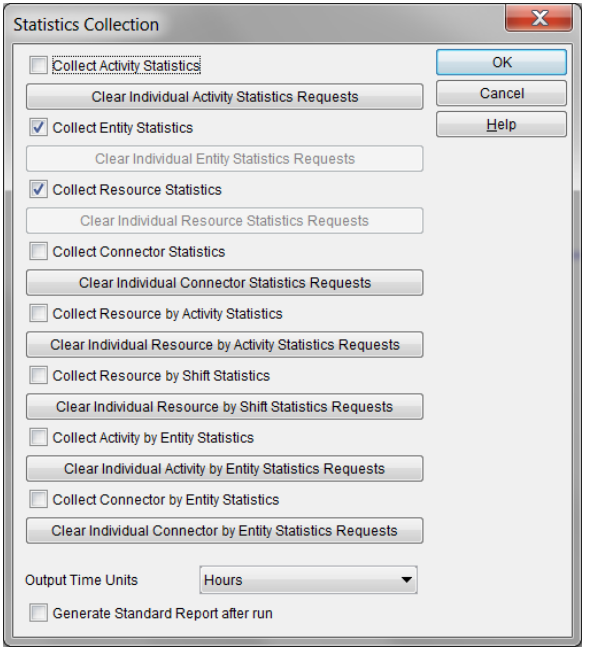
## *Default Performance Measures*

SIMPROCESS will collect by default the following performance statistics on Entities and Resources:

- For each Entity defined in the model, Cycle Time and Count statistics are displayed.
- For each Resource defined in the model, average and maximum number of units busy is measured and shown as a percent of capacity.

- ABC reports for each Resource with cost defined in the model. The ABC reports have three sections that are broken down by cost period and total cost. These sections are **Resource by Entity**, **Resource by Activity**, and **Activity by Entity**. If there are Resources from OrgModels that have costs assigned, there are two additional sections: **Org Node by Resource** and **Org Node Cumulative Costs**. See the *SIMPROCESS OrgModel Manual* for more information on OrgModels, OrgNodes, and Resources. See Chapter 7–Activity-Based Costing, beginning on page 219 for more detail on Activity-Based Costing.

On the **Report** menu, **Define Global Statistics Collection** brings up a dialog that sets global statistics options. As stated above, **Collect Entity Statistics** and **Collect Resource Statistics** are selected. The results of the selection options are described in the following sections. The **Output Time Units** field sets the units for cycle time statistics in the Standard Report. **Generate Standard Report after run** causes the Standard Report to be generated automatically after a simulation run. This is most useful when using the Experiment Manager or optimization (OptQuest for SIMPROCESS). Note that Standard Reports generated automatically are not accessible from within SIMPROCESS. The file (which is located in the model's directory) must be opened separately.


Statistics Collection
Collect Activity Statistics
Clear Individual Activity Statistics Requests
Collect Entity Statistics
Clear Individual Entity Statistics Requests
Collect Resource Statistics
Clear Individual Resource Statistics Requests
Collect Connector Statistics
Clear Individual Connector Statistics Requests
Collect Resource by Activity Statistics
Clear Individual Resource by Activity Statistics Requests
Collect Resource by Shift Statistics
Clear Individual Resource by Shift Statistics Requests
Collect Activity by Entity Statistics
Clear Individual Activity by Entity Statistics Requests
Collect Connector by Entity Statistics
Clear Individual Connector by Entity Statistics Requests
Output Time Units
Hours
Generate Standard Report after run
OK
Cancel
Help

Attributes are handled differently for the Standard Report. The **Standard Report** check box on the **Attribute Properties** dialog must be selected for each attribute that needs to collect statistics. The report will display either Time-weighted or Observation-based statistics depending on the option chosen. Statistics can be kept for all types of attributes except Entity Instance Attributes. Lastly, if the value

of an attribute does not change during the simulation run, its statistics will all be zeroes in the Standard Report. See “User Defined Attributes” for more information on Attributes.

# Custom Statistics

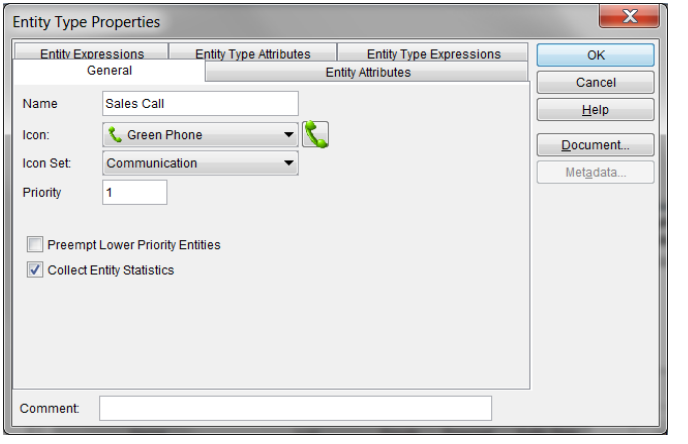
SIMPROCESS provides the ability to add custom statistics to the Standard Report for analyzing the performance of business Processes. Performance measures such as cycle time, Activity costs, and Resource utilization can be calculated by SIMPROCESS. This chapter describes the types of statistics available, and how to define, display, print, and export them.

## *Entity Statistics*

Entity statistics provide detailed information about the numbers of Entities existing in the model during a simulation and the amount of simulation time (cycle time) that Entities require to pass through the model. SIMPROCESS provides five types of Entity statistical reports:

- Total Count
- Entity Count by State
- Entity Cycle Time by State
- Real-time Plots
- Attribute Value

Total Count, Entity Count by State, and Entity Cycle Time by State are selected either from the **Define Global Statistics Collection** dialog by choosing **Collect Entity Statistics** or by choosing **Collect Entity Statistics** when each Entity is defined. If **Collect Entity Statistics** on the **Define Global Statistics Collection** dialog is selected, then the above statistics (other than Real-time Plots and Attribute Value) will be in the Standard Report for every Entity defined. If only statistics for selected Entities are desired, then the global **Collect Entity Statistics** should not be selected, and the **Collect Entity Statistics** on the Entity Definition dialog should be selected for the desired Entities.



### *Total Count Statistics*

These statistics show the total number of Entities that have been generated during the simulation, how many remain in the system at the end of the simulation, and how many have exited the system throughout the simulation.

### *Entity Count by State Statistics*

These statistics present the simulation-generated Entity count statistics for selected Entity types. Statistics are time-weighted for Entity counts. These statistics show the average number of Entities in the system broken down by four states: in-process, waiting for Resource, holding for condition, and traveling.

### *Cycle Time by State Statistics*

Cycle Time statistics present the simulation-generated cycle time statistics for selected Entity types. The cycle time calculations are based on the number of Entities that were processed at the end of the simulation. These statistics show the breakdown of the Cycle Time by state. The four states that an Entity may be in are in-process, waiting for Resource, holding for condition, and traveling.

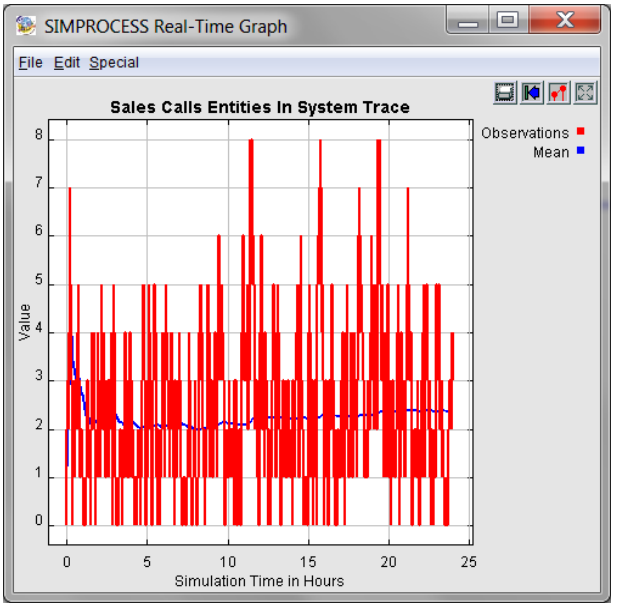
### *Real-time Plots*

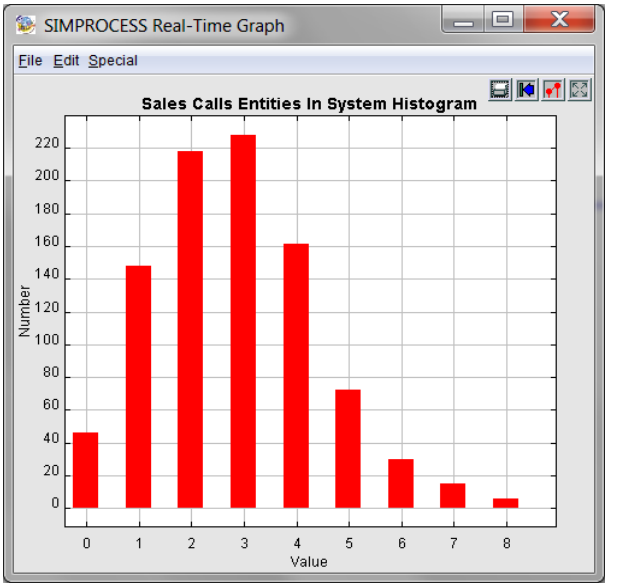
Real-time plots display statistics while the simulation is running. This may slow the simulation but real-time plots give a running view of the performance metrics during the simulation. If multiple real-time plots are selected, they will be stacked on top of each other. Real-time plots can be minimized, moved, resized, or closed while the simulation is running. Real-time plots that have been closed can be displayed again. See “Displaying Real-Time Plots” on page 263.

There are two types of real-time plots: traces and histograms. Traces display the instantaneous value of a particular statistic along with a running mean. Histograms display the number of occurrences of values of a statistic. These are grouped into value ranges called bins. The bin size is set automatically by SIMPROCESS. Traces and histograms for the same statistic do not have to be displayed together. Individual charts may be selected. Real-time plots are selected under the **Report** menu item **Real-Time Plots**. Plots may be customized and hidden. See “Real-Time Plots” on page 259.

**Cycle Times Trace** and **Cycle Times Histogram** — These reports show the individual cycle time measurements for each Entity of a given type. Charts are generated for each Entity type that is selected. The charts are updated as each Entity of the given type completes its cycle time. This occurs when the Entity is transformed or disposed in the model. The observation points on the trace are connected only to improve their visibility and are not meant to suggest continuity.

**Entities in System Trace** and **Entities in System Histogram** — These charts show the individual Entity count measurements (that is, the number of Entities that exist in the model) for each Entity type. Charts are generated for each Entity type that is selected. The charts are updated as each Entity of the given type is created and disposed in the model.




**Wait For Resource Trace** and **Wait For Resource Histogram** — These charts show the current number of Entities that are in the waiting for Resource state.

**Wait For Resource Cycle Times Trace** and **Wait For Resource Cycle Times Histogram** — These charts show the time spent waiting for Resources.

**Hold For Condition Trace** and **Hold For Condition Histogram** — These charts show the current number of Entities that are in the holding for condition state that may be associated with Activities such as Assemble, Gate, and Batch.

**Hold For Condition Cycle Times Trace** and **Hold For Condition Cycle Times Histogram** — These charts show the time spent holding for a condition to be met.

**Entities In Process Trace** and **Entities In Process Histogram** — These charts show the current number of Entities that are in the Process.

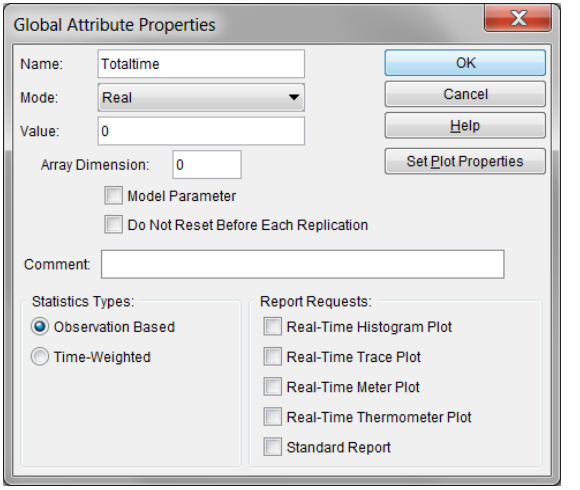
**Process Cycle Times Trace** and **Process Cycle Times Histogram** — These charts show the time Entities spend processing.

**Entities Traveling Trace** and **Entities Traveling Histogram** — These charts show the current number of Entities that are traversing Connectors.

**Travel Times Trace** and **Travel Times Histogram** — These charts show the time Entities spend traversing Connectors.

### *Attribute Value Statistics*

The attribute value statistics must be specified in the dialogs where attributes themselves are defined. If the attributes are defined while Entity types are being defined, then the statistics must be selected where those attributes are defined.



**Time-Weighted Average** — This collects time-weighted statistics for Entity attributes.

**Observation-Based Average** — This collects observation-based statistics for Entity attributes.

**Real-Time Histogram Plot** — This displays a histogram of the attribute's values.

**Real-Time Trace Plot** — This displays a trace of the attribute's values.

**Real-Time Meter Plot** — This displays the attribute's value on a meter.

**Real-Time Thermometer Plot** — This displays the attribute's value on a thermometer.

**Standard Report** — Displays the results in the Standard Report.

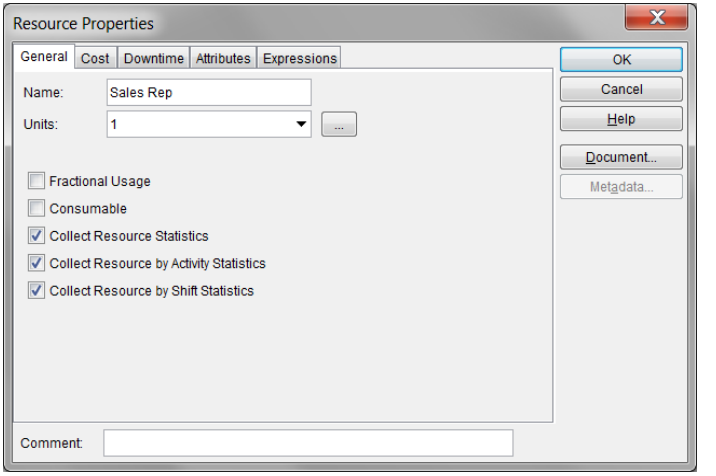
**Set Plot Properties** — Displays a plot properties dialog for each type of plot selected.

## *Resource Statistics*

Resource statistics provide detailed information about the amount of time Resources spend in possible states during a simulation. SIMPROCESS provides four types of statistics which show various summaries of the state information for a Resource:

- Utilization by State Statistics
- Utilization by Activity Statistics
- Utilization by Shift Statistics
- Real-time Plots
- Attribute Value Statistics

Utilization by State is selected either from the **Define Global Statistics Collection** dialog by choosing **Collect Resource Statistics** or by choosing **Collect Resource Statistics** when each Resource is defined. The Utilization by State statistics will be in the Standard Report for every Resource defined if **Collect Resource Statistics** on the **Define Global Statistics Collection** dialog is selected. The global **Collect Resource Statistics** should not be selected, and the **Collect Resource Statistics** on the Resource Definition dialog should be selected if only statistics for selected Resources are desired. Similarly, Utilization by Activity and Utilization by Shift are selected either from the **Define Global Statistics Collection** dialog by choosing **Collect Resource by Activity Statistics** and **Collect Resource by Shift Statistics** or by choosing **Collect Resource by Activity Statistics** and **Collect Resource by Shift Statistics** when each Resource is defined. See "Resource Shifts" for information on Resource Shifts.




### *Utilization by State Statistics*

These statistics present summaries of the simulation-generated statistics for the time that the number of units of the selected Resources spent in each state. The average number of units and percentages that were idle, busy, planned downtime, unplanned downtime, and reserved are shown in the Standard Report. Also included in the Standard Report are the percentages that a Resource was idle, busy, or reserved, given the Resource was available. That is, downtime (planned or unplanned) is not included. The time available is considered to be the total time for the Resource. Thus, if a Resource has no downtime defined, then the percentages for idle, busy, and reserved will be the same for the calculations including downtime and the calculations not including downtime.

### *Utilization by Activity Statistics*

These statistics show the average number of units that were busy by Activity.

### *Utilization by Shift Statistics*

These statistics show the average number of units that were busy by Resource Shift. (See "Resource Shifts" for information on defining and using Resource Shifts.)

### *Real-time Plots*

These reports display the simulation-generated instantaneous capacity allocations for each of the five Resource states. The reports present their data while the simulation is running. This may slow the simulation but they provide a running view of the Resource's behavior throughout the simulation. Real-time plots are selected under the **Report** menu item **Real-Time Plots**.

All report data is shown on an X-Y plot where the (horizontal) X-Axis represents simulation time and the (vertical) Y-Axis shows the Resource's units. One chart is produced for each selected Resource. Plots may be customized and hidden. See “Real-Time Plots” on page 259.

**Capacity Trace** and **Capacity Histogram** —These reports show the capacity of a Resource during the simulation. These plots are only useful for consumable Resources.

**Units Idle Trace** and **Units Idle Histogram** —These reports show the amount of a Resource's units which are left idle during the simulation.

**Units Busy Trace** and **Units Busy Histogram** —These reports show the amount of a Resource's units which are busy during the simulation.

**Units Reserved Trace** and **Units Reserved Histogram**—These reports show the amount of a Resource's units which are in reserved state during the simulation.

**Availability Trace** and **Availability Histogram** — These reports show the amount of a Resource’s units that are **not** down due to planned or unplanned downtime. The units displayed could be idle, busy, or reserved.

**Scheduled Availability Trace** and **Scheduled Availability Histogram** — These reports show the amount of a Resource’s units that are scheduled to be available. As with the **Availability Trace** and **Availability Histogram**, the units displayed could be idle, busy, or reserved; however, unplanned downtime is also included as scheduled availability. Thus, only planned downtime shows unavailability.

**Planned Downtime Trace** and **Planned Downtime Histogram** —These reports show the amount of a Resource's units which are not available due to planned downtime during the simulation.

**Unplanned Downtime Trace** and **Unplanned Downtime Histogram** —These reports show the amount of a Resource's units which are not available due to unplanned downtime during the simulation.

**Total Downtime Trace** and **Total Downtime Histogram** —These reports show the amount of a Resource's units which are not available due to unplanned and planned downtime during the simulation.

### *Attribute Value Statistics*

The attribute value statistics must be specified in the dialogs where attributes themselves are defined. If the attributes are defined while Resources are being defined, then the statistics must be selected where those attributes are defined.

**Time-Weighted Average** — This collects time-weighted statistics for Resource attributes.

**Observation-Based Average** — This collects observation-based statistics for Resource attributes.

**Real-Time Histogram Plot** — This displays a histogram of the attribute’s values.

**Real-Time Trace Plot** — This displays a trace of the attribute's values.

**Real-Time Meter Plot** — This displays the attribute's value on a meter.

**Real-Time Thermometer Plot** — This displays the attribute's value on a thermometer.

**Standard Report** — Displays the results in the Standard Report.

## *Process/Activity Statistics*

Process/Activity Statistics provide detailed information about the numbers of Entities entering and leaving particular Processes/Activities during a simulation. SIMPROCESS provides seven types of Activity statistics:

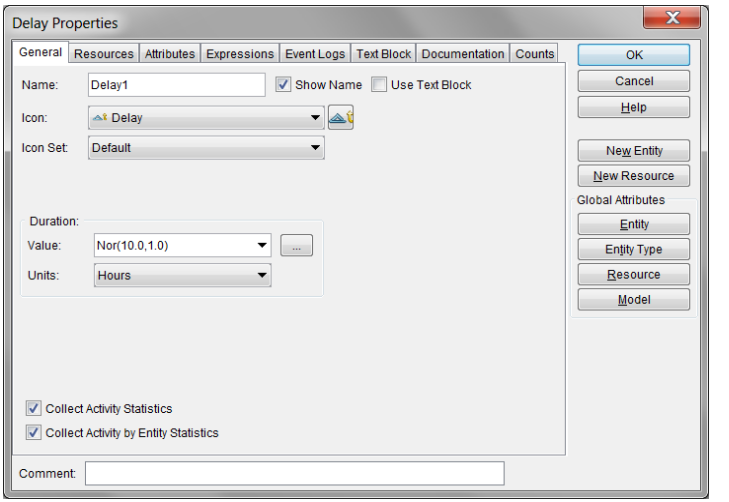
- Total Entity Counts
- Total Entity Counts by Entity
- Entity Count by State
- Entity Count by State by Entity
- Cycle Time by State
- Cycle Time by State by Entity
- Real-time Plots
- Attribute Values

The Process/Activity statistics are limited in scope to specific Processes/Activities in contrast to Entity statistics which encompass the entire model. Cycle Time by State, Total Entity Counts, and Entity Count by State are selected globally from the **Define Global Statistics Collection** dialog by choosing **Collect Activity Statistics** or locally by choosing **Collect Activity Statistics** on the individual Activity properties dialog. Activity statistics will be in the Standard Report for every Activity defined if **Collect Activity Statistics** on the **Define Global Statistics Collection** dialog is selected. The global **Collect Activity Statistics** should not be selected, and the local **Collect Activity Statistics** on the Activity properties dialog should be selected if only statistics for selected Activities are desired. Similarly, Total Entity Counts by Entity, Cycle Time by State by Entity and Entity Count by State by Entity are selected globally from the **Define Global Statistics Collection** dialog by choosing **Collect Activity by Entity Statistics** or locally by choosing

**Collect Activity by Entity Statistics** on the appropriate Activity.

**WARNING**

> **Collect Activity Statistics** and **Collect Activity by Entity Statistics** should NOT be selected from the Global Statistics Collection dialog for large models unless an Activity Gantt Chart will be created. This could cause memory problems and would lead to much unneeded information. It is recommended that Activity statistics usually be selected at the appropriate Activity.




### *Entity Count Reports*

These reports present the simulation-generated Entity count statistics for selected Processes/Activities.

**Total Entity Count**—This report shows the total number of Entities that (1) have arrived at the Process/Activity, (2) are remaining in the Process/Activity at the end of the simulation, (3) have been processed by the Process/Activity, and (4) left the Activity without processing. These can also be broken down by Entity type.

**Count By Entity State**—This report shows the average and maximum Entity counts broken down by Entity states, that were processed by the selected Activity. That is, how many were in the Activity, Wait For Resource, In Process, and Hold for Condition states. Entity counts for Processes will not be broken down by state. These can also be viewed by Entity type.

### *Cycle Time by State Statistics*

These statistics present the simulation-generated cycle time statistics for the selected Process/Activity and are calculated based on the Entity counts for the selected Processes/Activities.

Cycle Time statistics present the simulation-generated cycle time statistics for Entity types that processed at the selected Activities or Processes. The cycle time calculations are based on the number of Entities that were processed at the end of the simulation. These statistics show the breakdown of the Cycle Time by state. The three states that an Entity may be in are waiting for Resource, holding for condition, and in-Process. Cycle Time will not be broken down by state for Processes. These statistics can also be broken down by Entity type.

### *Real-time Plots*

Real-time Plots display statistics while the simulation is running. This may slow the simulation but shows a running view of the Entity count throughout the simulation. The selected charts are generated for each Process/Activity selected. The observation points are connected in trace charts to improve their visibility and are not meant to suggest continuity. See “Real-Time Plots” on page 259.

**Cycle Times Trace** and **Cycle Times Histogram** —These charts show the individual cycle time measurements for each Process/Activity.

**Wait For Resource Cycle Times Trace** and **Wait For Resource Cycle Times Histogram** —These charts show the individual wait for Resource time measurements for each Activity. These charts are not available for Processes.

**Hold For Condition Cycle Times Trace** and **Hold For Condition Cycle Times Histogram** —These charts show the hold for condition time measurements for each Activity. These charts are not available for Processes.

**Process Cycle Times Trace** and **Process Cycle Times Histogram** —This chart shows the processing time measurements for each Activity. These charts are not available for Processes.

**Entity Counts Trace** and **Entity Counts Histogram** —These charts show the number of Entities in each Process/Activity.

**Wait For Resource Trace** and **Wait For Resource Histogram** —These charts show the number of Entities waiting for Resources for each Activity. These charts are not available for Processes.

**Hold For Condition Trace** and **Hold For Condition Histogram** —These charts show the number of Entities holding for a condition for each Activity. These charts are not available for Processes.

**Entities In Process Trace** and **Entities In Process Histogram** —These charts show the number of Entities processing for each Activity.

### *Attribute Value Reports*

The attribute value reports must be specified in the dialogs where the attributes themselves are defined. If the attributes are defined locally for a Process/Activity, then the reports must be selected where those attributes are defined.

**Time Weighted Average**—This collects time-weighted statistics for the selected Process/Activity attributes.

**Observation Based Average** — This collects observation-based statistics for the selected Process/ Activity attributes.

**Real-Time Histogram Plot** — This displays a histogram of the attribute's values.

**Real-Time Trace Plot** — This displays a trace of the attribute's values.

**Real-Time Meter Plot** — This displays the attribute's value on a meter.

**Real-Time Thermometer Plot** — This displays the attribute's value on a thermometer.

**Standard Report** — Displays the results in the Standard Report.

## *Connector Statistics*

Connector Statistics provide detailed information about the numbers of Entities entering and leaving particular Connectors during a simulation. SIMPROCESS provides seven types of Connector statistics:

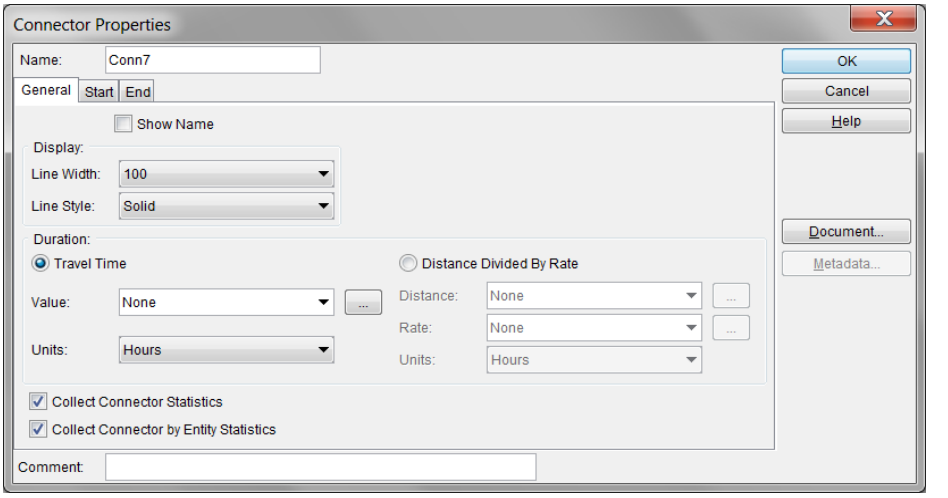
- Total Entity Counts
- Total Entity Counts by Entity
- Entity Count
- Entity Count by Entity
- Cycle Time
- Cycle Time by Entity
- Real-time Plots

The Connector statistics are limited in scope to specific Connectors in contrast to Entity statistics which encompass the entire model. Cycle Time, Total Entity Counts, and Entity Count are selected globally from the **Define Global Statistics Collection** dialog by choosing **Collect Connector Statistics** or locally by choosing **Collect Connector Statistics** on the individual Connector properties dialog. Connector statistics will be in the Standard Report for every Connector defined if **Collect Connector Statistics** on the **Define Global Statistics Collection** dialog is selected. The global **Collect Connector Statistics** should

not be selected, and the local **Collect Connector Statistics** on the Connector properties dialog should be selected if only statistics for selected Connectors are desired. Similarly, Total Entity Counts by Entity, Cycle Time by Entity and Entity Count by Entity are selected globally from the **Define Global Statistics Collection** dialog by choosing **Collect Connector by Entity Statistics** or locally by choosing **Collect Connector by Entity Statistics** on the appropriate Connector. Connector statistics are usually only needed for Connectors with a **Duration**.

**WARNING**

> **Collect Connector Statistics** and **Collect Connector by Entity Statistics** should NOT be selected from the Global Statistics Collection dialog for large models. This could cause memory problems and would lead to much unneeded information. It is recommended that Connector statistics always be selected at the appropriate Connector.




### *Entity Count Reports*

**Total Entity Count**—This report shows the total number of Entities that (1) have arrived at the Connector, (2) are remaining in the Connector at the end of the simulation, and (3) have traversed the Connector. These statistics can be broken down by Entity type.

**Entity Count**—This report shows the average and maximum Entity counts. These can be broken down by Entity type.

### *Cycle Time Statistics*

These statistics present the simulation-generated cycle time statistics for the selected Connector and are calculated based on the Entity counts for the selected Connectors. The cycle time calculations are

based on the number of Entities that were processed at the end of the simulation. These statistics can be broken down by Entity type.

### *Real-time Plots*

Real-time Plots display statistics while the simulation is running. The charts are generated for each Connector selected. The observation points are connected in trace charts to improve their visibility and are not meant to suggest continuity. Plots may be customized and hidden. See “Real-Time Plots” on page 259.

**Cycle Times Trace** and **Cycle Times Histogram** —Individual cycle time measurements for each Connector.

**Entity Counts Trace** and **Entity Counts Histogram** —Number of Entities in each Connector.

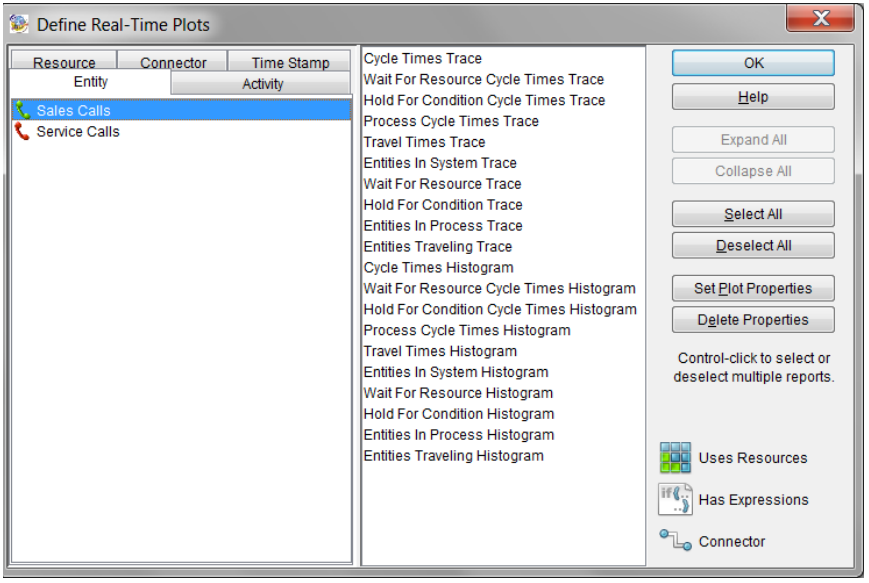
# Real-Time Plots

Real-Time Plots display the change in value of statistics as the simulation runs for Entities, Resources, Activities, Processes, Connectors, Time Stamps, and Attributes.

## *Defining Plots*

### *Entities, Resources, Activities, and Connectors*

Plots for Entities, Resources, Activities, Processes, and Connectors are defined on the **Report** menu.




Selecting **Real-Time Plots**... will display a dialog with five tabs on the left (**Entity**, **Activity**, **Resource**, **Connector**, and **Time Stamp**). Select an item from one of the tabs on the left, then select the plots desired on the right. Multiple items can be selected on the right by holding down the Control key when selecting. The **Select All** button can be used if all plots are desired. The **Deselect All** button deselects all plots for the item selected on a tab on the left.

Once the desired plots have been selected, click **OK**. During the simulation, when the first value occurs for a particular plot, the plot appears. The plot will remain unless minimized or closed. Real-time plots

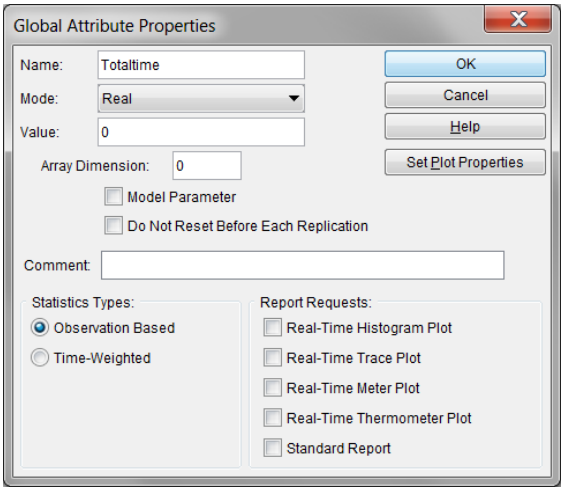
that have been closed can be displayed again.

**NOTE**

> Real-Time plots that have been displayed will not automatically disappear at the end of a simulation run. Each one must be closed individually. Note that all open plots will be closed when SIMPROCESS is closed.

### *Attributes*

Attribute plots are selected on the attribute definition dialog. All attribute types except Entity Instance attributes can have plots. Plots will be created for each item defined in the model if the attribute is a global Entity, global Resource, or global Activity attribute. For instance, if there are ten Activities/ Processes in a model, and a global Activity attribute is defined with plots, then 10 sets of plots will be created since each Activity will have the attribute. Except for Model attributes, it is best to use local attributes when selecting plots for an attribute. Also, if an attribute is an array attribute, plots will be created for each member of the array.



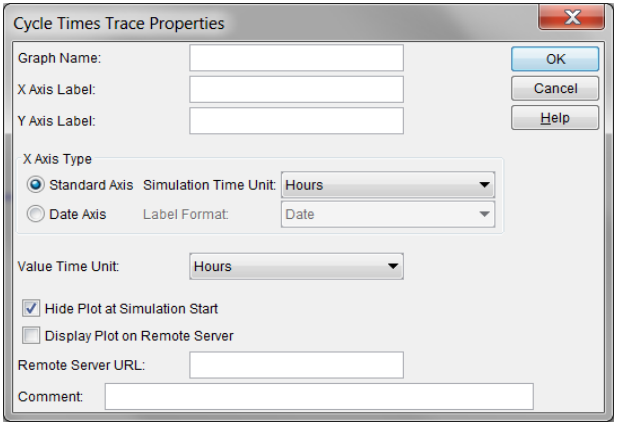

## *Setting Plot Properties*

Each item that can have plots has a **Set Plot Properties** button. The properties depend on the type of plot.When plots are deselected, any properties set are lost. The properties must be reset if the plot is selected again. Also, on the **Real-Time Plots** dialog for Entities, Resources, Activities, Connectors, and Time Stamps, there is a **Delete Properties** button. This button will remove the plot properties from

selected plots without deselecting the plots.

### *Trace and Histogram Properties*

For Trace and Histogram plots this button sets the plot title, sets the X axis legend, sets the Y axis legend, hides the plot at the start of the simulation, and, depending on plot type, sets X axis type and the units for the X axis and Y axis. For histogram plots the bin width can be set (defaults to 1.0). For trace plots, the X axis can either be a standard axis (default) or a date axis. A date axis displays a date and/or time instead of numbers. If the plot properties are not set, defaults will apply to the plots. The default title is the item name plus the plot name. For instance, the default title for a trace of cycle times for an Activity named Delay1 would be "Delay1 Cycle Times Trace." For a standard X axis the default units for the X axis of trace plots is the **Simulation Time Unit** selected in the Run Settings. (See "Setting the Simulation Time Unit" on page 108.) The default units for the Y axis of trace plots depends on the type of value being plotted. If the value is a cycle time (total, processing, wait for Resource, hold for condition, or traveling), the default unit is the **Output Time Units** selected in the **Define Global Statistics Collection** dialog. If the value is not a cycle time, then the Y axis is set according to the values plotted. Histograms follow the same rules for the X axis since the X axis plots the values in a histogram. To change any of the defaults, or to hide the plot, choose the **Set Plot Properties** button. This button will display a dialog for each plot selected.

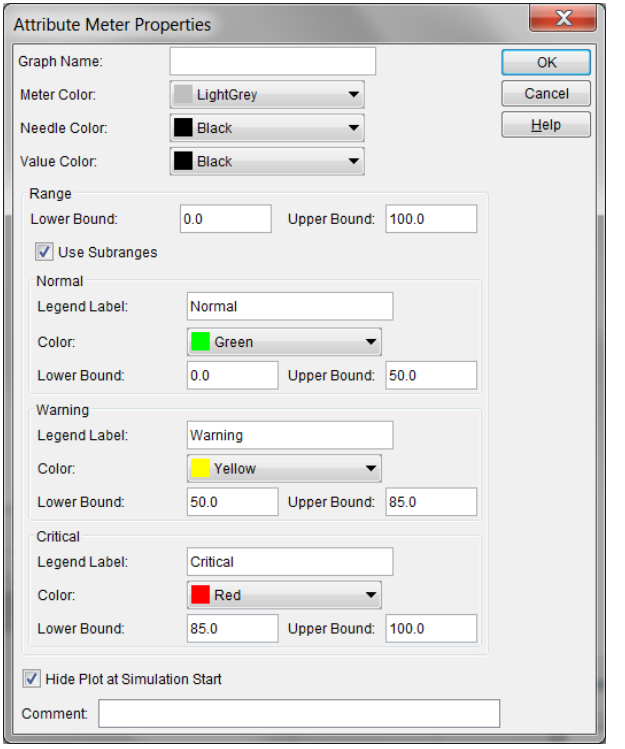



Defaults will apply if **Graph Name**, **X Axis Label**, or **Y Axis Label** are left blank. The **X Axis Type** defaults to **Standard Axis** with *Hours* selected for the **Simulation Time Unit**. When **Date Axis** is selected, **Label Format** activates. **Label Format** designates the type of date and/or time labels to display on the X axis. The possible options for **Label Format** are *Date*, *Time*, and *Date and Time*. Note that the *Time* format should only be used when the simulation length is 24 hours or less. The date and time formats adjust based on the location selected for the operating system. A United States location will display Jan 21, 2005 as 1/21/05, whereas a European location will display as 21/1/05. The plot properties default to hide the plot and to not display the plot on a remote server. The plot properties dialog will display **X**

**Axis Type** and **Value Time Unit** based on the plot type and the value being plotted. Traces of cycle times will offer both options. All other traces will only offer the **X Axis Type** option. Histograms of cycle times will offer the **Value Time Unit** option. All other histograms will not have either option. The **Bin Width** field for histograms must have a value greater than zero.

### *Meter and Thermometer Properties*

In addition to Trace and Histogram plots, Attributes can have Meter and Thermometer plots. The properties for these plots include the name of the plot, the range and (optionally) subranges of the plot, and whether to hide the plot at simulation start. For Meter plots, the color of the meter, the needle, and the value can be specified. For Thermometer plots, the color of the mercury and the color of the value can be set. Below are the properties of an Attribute Thermometer plot.

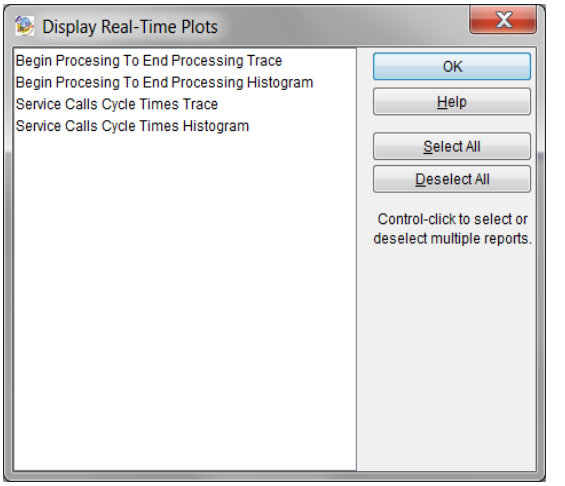



The **Range** must be set based on the range of values the Attribute will take on during the simulation. If **Use Subranges** is selected, the **Normal**, **Warning**, and **Critical** subranges will be active. The **Legend Label** field displays in the corresponding area of the Meter. Thermometer plots do not have a **Legend Label**.

## Displaying Real-Time Plots

Plots that are hidden are displayed during or after a simulation by choosing **Display Real-Time Plots** on the **Report** menu or clicking the button on the tool bar. These only become active at the beginning of a simulation run.

A dialog appears that lists all plots (hidden or not) defined in the model. All the plots are listed in the same dialog regardless of type (Entity, Resource, etc.).




The plots that are selected will display when **OK** is pressed. Once a plot is displayed it can be minimized or closed. Any plot closed can be viewed again by using **Display Real-Time Plots** from the **Report** menu or the tool bar. All plots remain available for display until the model is closed. The plots are recreated if the model is run again.

## Displaying Plots Remotely

The ability to display real-time plots on a remote server is a plug-in capability that can be licensed separately from CACI. The **Display Plot on Remote Server** option must be selected, and the **Remote Server URL** must be entered.

Before the model with the remote plots starts simulation, the Java RMI Registry must be started and

SPPlotServer must be started on the server where the remote plots are to appear. This requires the use of the `SPRemote.jar` and `plot.jar` files which are found in the `SPSYSTEM` directory where SIMPROCESS was installed (copy these to another system as required). To use the same system enter `rmi://localhost/` for the **Remote Server URL** field. To display the plots on a different system, change `localhost` to an appropriate value that will resolve to the Internet Protocol (IP) address of the system where the RMI Registry and SPPlotServer are located. Alternatively, just use the actual IP number.

To start the RMI Registry, a batch file or UNIX shell script can be constructed, because the RMI Registry program is required to have in its classpath the locations of files referenced by server Processes. Here are some examples of what should be contained in those files:

Windows batch file:

```
set CLASSPATH=SPRemote.jar
rmiregistry
```

UNIX shell script using the Bourne shell or a derivative:

```
CLASSPATH=SPRemote.jar
export CLASSPATH
rmiregistry
```

UNIX shell script using the C shell or a derivative:

```
setenv CLASSPATH SPRemote.jar
rmiregistry
```

Sample batch files and scripts are located in the `SPUser\SampleFiles` directory. `SPUser` is in the SIMPROCESS working directory (see "SIMPROCESS Working Directory"). The sample batch files and scripts are intended to be used in the SIMPROCESS installation directory but can be modified to run from other locations. Administrator privileges may be required to run a sample batch file from the SIMPROCESS installation directory.

Adjust the precise CLASSPATH value as needed, based on where the copy of `SPRemote.jar` is located and the current working directory. Once the RMI Registry program is started, SPPlotServer can then be started. When using `localhost`, enter this command from the SIMPROCESS directory on the system where SIMPROCESS is installed:

```
jre\bin\java -classpath SPSYSTEM\SPRemote.jar;SPSYSTEM\plot.jar
com.caci.remote.SPPlotServer
```

Alternatively, the `PlotServ` batch or script file in the `SPUser\SampleFiles` directory can be run. Simply copy the appropriate file to the SIMPROCESS installation directory before running (administrator privileges may be required).

If not using `localhost`, from the directory where SPRemote.jar and plot.jar are located, enter this command:

```
jre\bin\java -classpath SPRemote.jar;plot.jar
com.caci.remote.SPPlotServer
```

Use colons in the classpath for non-Windows systems. Once the Java RMI Registry and SPPlotServer have been started, load and run the model.

Note that remote plots are not plotted locally. Real-time plots are created either locally or remotely, but not both. Remote real-time plots cannot be hidden (even if selected in the Real-Time Plot Properties). That is, they will display as soon as simulation data is sent to the plot. Also, once a remote real-time plot has been closed, there is no way to reopen it since remote real-time plots are not in the list of plots available through the **Display Real-Time Plots** button or menu item.

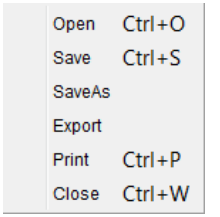
## Automatic Saving of Plots

Plots are automatically saved in the `plots` directory (which is created in the model's directory) at the end of a simulation run. Only local plots are saved. All plots are saved using the name of the plot as the name of the file. When creating the file name, some special characters (:, !, @, #, $, %, ^, &, *, /, and \) in the name of the plot are replaced by underscores. Note that not all special characters are replaced, and, depending on the system and the special characters, special characters that are not replaced with underscores could cause an error during the automatic save of the plot. Trace plots have a `.trc` extension and histogram plots have an `.hst` extension. These plots will be overwritten each time the model is run. Thus, if a plot file needs to be saved, it should be renamed or moved, or the plot can be saved using the **File/Save** option. **Launch Plot Application** on the Report menu opens a plot window. Saved plots can be opened using the **File/Open** option of the plot window.

## Post Plotting Options

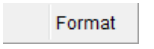
Each plot window has a menu and four buttons. These provide options to save, print, and format plots. Also, the plots have a zoom capability.

### *File Menu*

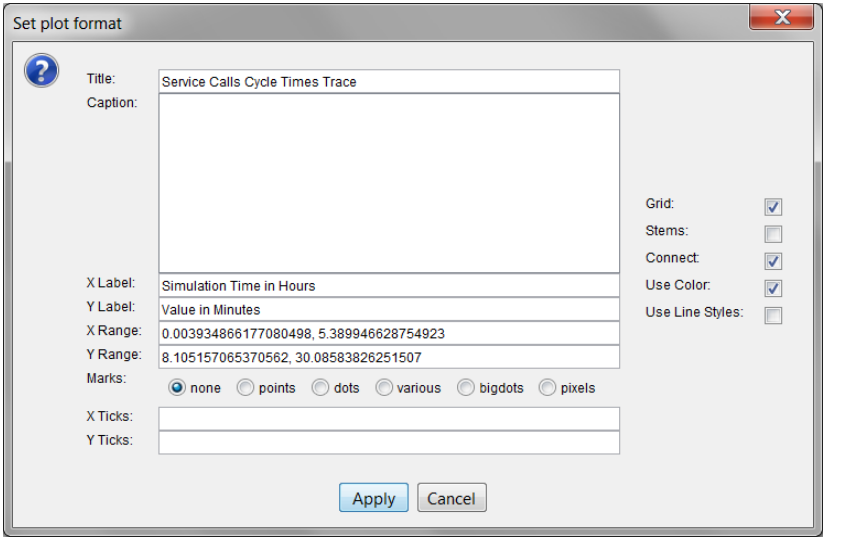



- **Open** - Opens a previously saved plot
- **Save** - Saves a plot in XML format
- **SaveAs** - Saves a previously saved plot under a new name
- **Export** - Saves the plot as an encapsulated postscript file
- **Print** - Prints the plot
- **Close** - Closes the plot window.

### *Edit Menu*




- **Format** - Changes the format of the plot




### *Special Menu*

- **About** - Lists information on plot developers
- **Help** - Limited information on zooming plots
- **Clear** - Erases the values plotted
- **Fill** - No effect on plot
- **Reset Axes** - Resets axes ranges to starting values

### *Plot Buttons*

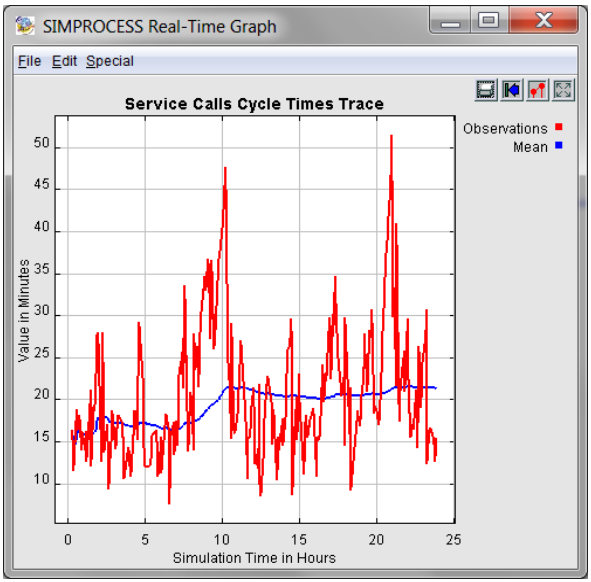
Button functions, as seen from left to right, are as follows:

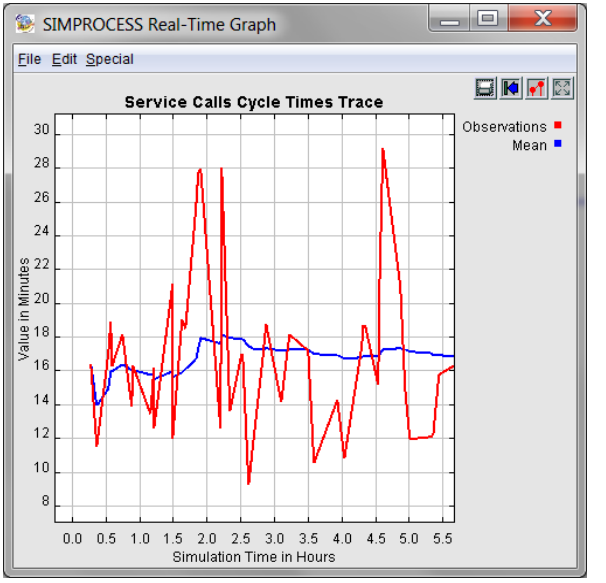
- Prints the plot. (Same as **File/Print**.)
- Resets the X and Y ranges to their original values. (Same as **Special/Reset Axes**.)

- Sets the plot format. (Same as **Edit/Format**.)
- Rescales the plot to fit the data. Used after zooming to return to full view of plot.

### *Plot Zooming*

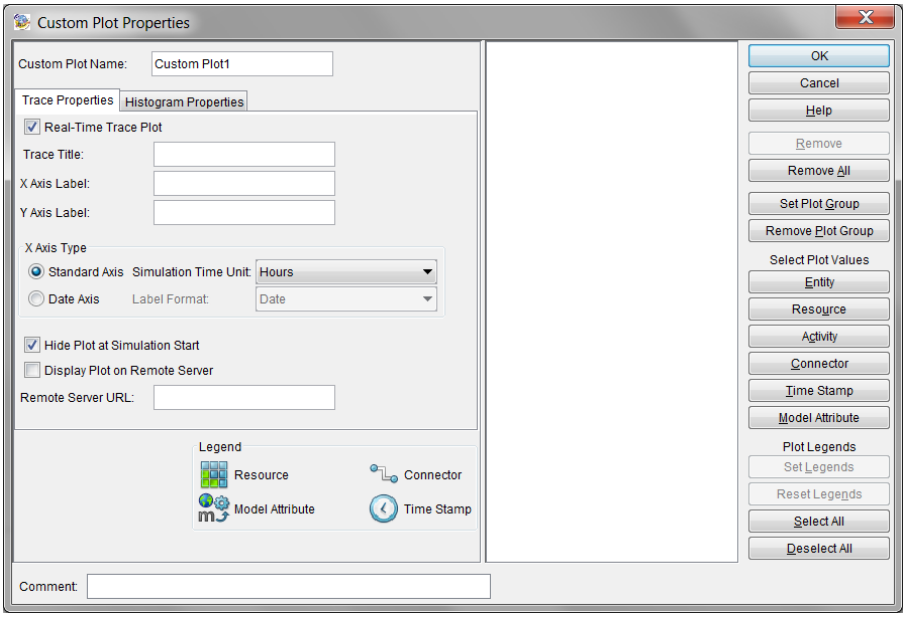
Once the simulation is complete, portions of the plot can be zoomed. To select the area for zooming, left mouse click at one corner of the area and drag over the area. When the mouse is released, that area will fill the plot. The following two plots demonstrate this. The first plot is the original plot. The second shows the plot with a portion zoomed.




SIMPROCESS Real-Time Graph
File Edit Special
Service Calls Cycle Times Trace
Observations
Mean
Value in Minutes
30
28
26
24
22
20
18
16
14
12
10
8
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5
Simulation Time in Hours

# Custom Plots

The real-time trace plots available from **Real-Time Plots** on the **Report** menu plot one value along with its mean. **Custom Real-Time Plots** offers the option of selecting more than one value to be on a trace and/or histogram plot. Thus, various values can be viewed in comparison with one another on the same plot. Selecting **Custom Real-Time Plots** brings up a dialog that lists the custom plots defined in the model. Clicking the **Add** button brings up a dialog that has the trace and histogram plot properties on the left and the list of values to plot on the right. Note that if a trace plot and histogram plot are selected, the values plotted are the same for both plots. Another custom plot must be defined if different values are to be on the trace plot and histogram plot. The plot properties on the left are the same as described on page 260.

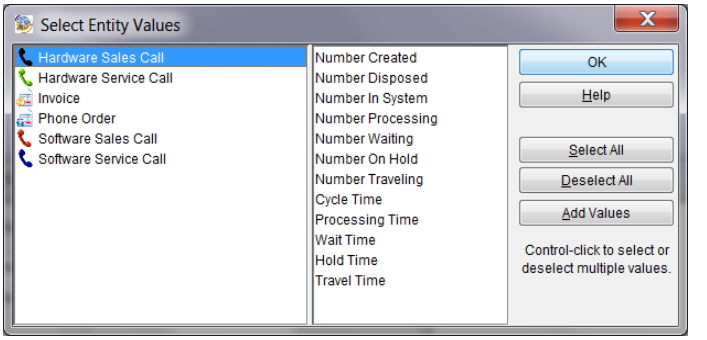



## *Adding Values To Custom Plots*

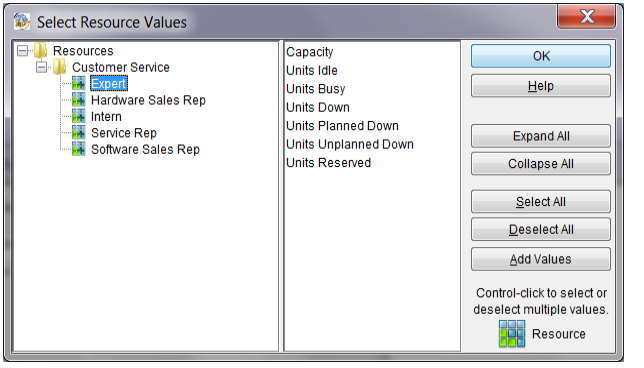
The buttons located under **Select Plot Values** of the Custom Plot Properties dialog determine which values will be plotted in the trace and/or histogram plots. The buttons are **Entity**, **Resource**, **Activity**, **Connector**, **Time Stamp**, and **Model Attribute** buttons. These buttons bring up the appropriate list of items along with the values that can be plotted.

**Entity** - displays a list of Entities defined in the model. Once an Entity has been selected, the values

for plotting appear. The values that can be plotted are Number Created, Number Disposed, Number In System, Number Processing, Number Waiting, Number On Hold, Number Traveling, Cycle Time, Processing Time, Wait Time, On Hold Time, and Travel Time.

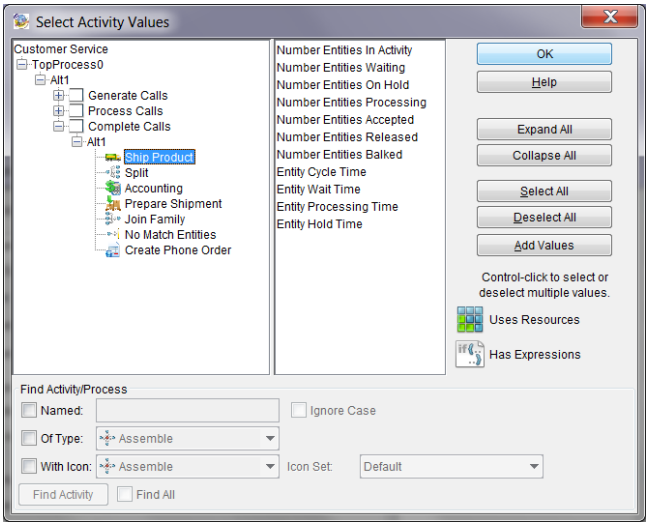



**Resource** - displays a tree of Resources defined in the model. Once a Resource has been selected, the values available for plotting appear. The values that can be plotted are Capacity, Units Idle, Units Busy, Units Down, Units Planned Down, Units Unplanned Down, and Units Reserved.

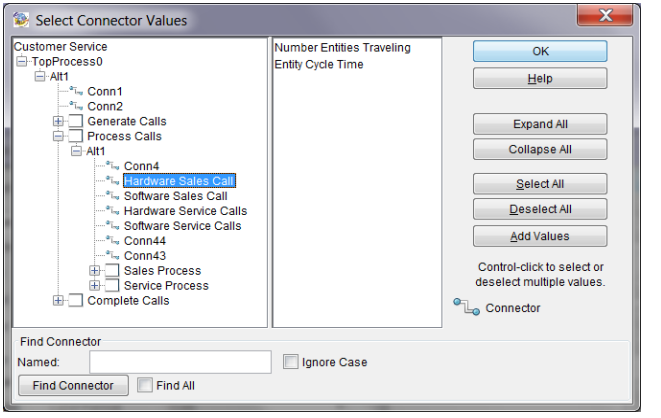



**Activity** - displays a hierarchical tree of the model. Once a Process or Activity has been selected, the values available for plotting for that item appear. The values that can be plotted for Processes are Number Entities In Process and Entity Cycle Time. The values that can be plotted for Activities are Number Entities In Activity, Number Entities Waiting, Number Entities On Hold, Number Entities Processing, Number Entities Accepted, Number Entities Released, Number Entities Balked, Entity Cycle Time, Entity Wait Time, Entity Processing Time, and Entity On Hold Time. The hierarchical tree can be searched with the same options that are on the Activity Browser (page 34). The difference is there is a **Find All** option. When selected, all Activities or Processes that match the search criteria are displayed. Note that when **Find All** is selected, the search cannot return both Activities and Processes.

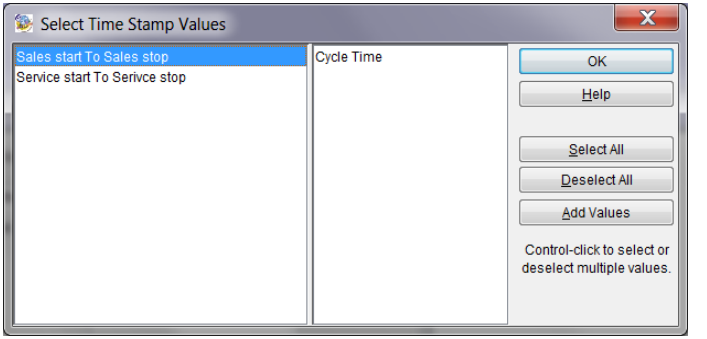
The result of the search should only return Activities or Processes. When a group of the same type is selected and **Add Values** is clicked, the selected statistics are added for all items in the group.



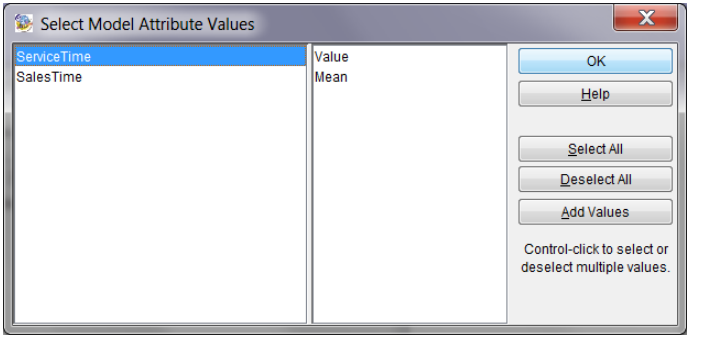

**Connector -** displays a hierarchical tree of the model displaying only Processes, Process Alternatives and Connectors. Once a Connector has been selected, the values available for plotting for that item appear. The values that can be plotted for Connectors are Number Entities Traveling and Entity Cycle Time.The hierarchical tree can be searched with the same options that are on the Connector Browser (page 36). The difference is there is a **Find All** option. When selected, all Connectors that match the search criteria are displayed. When **Add Values** is clicked, the selected statistics are added for all items in the group.



**Time Stamp** - displays the Time Stamps defined in the model. Once a Time Stamp has been selected, the only value available for plotting is Cycle Time.



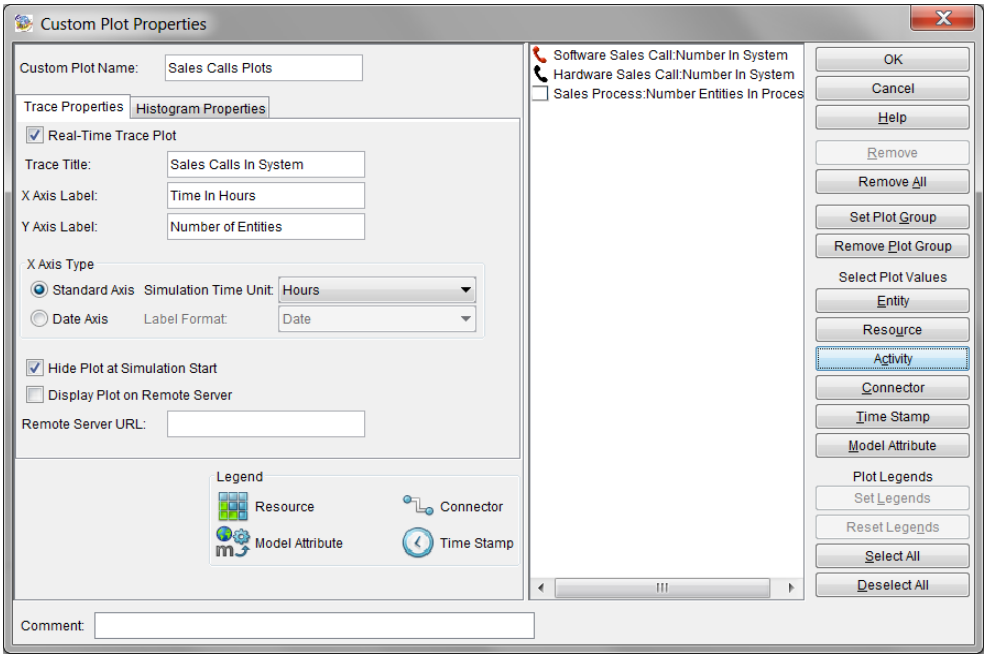

**Model Attribute** - displays a list of the **Integer** and **Real** Model Attributes defined in the model. Array attributes are listed by element. Once an attribute has been selected, the values available for plotting appear for that attribute. The values that can be plotted are the Value of the attribute and the Mean of the attribute. The Mean is the observation mean.

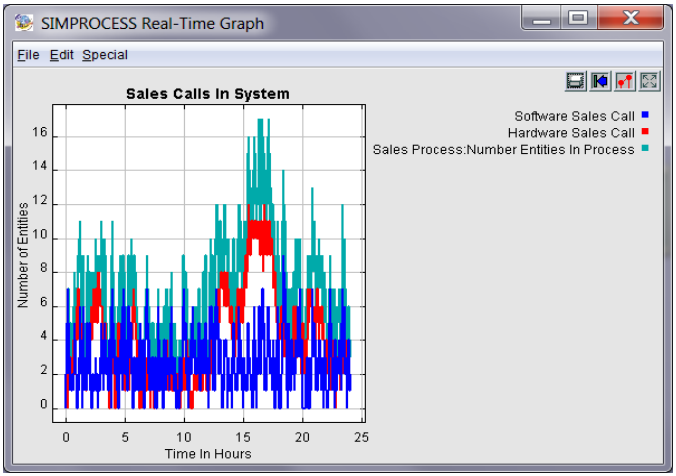



Values can be added to the plot from each type (Entity, Resource, etc.). However, adding values from different types and within types must be done with care. The units for each of the values should match. For instance a cycle time should not be plotted along with a number of Entities value (for example, Number In System). Those types of values have different units.

To add values, select the item on the left and the values desired on the right. Only one item on the left can be selected at a time. However, multiple values on the right can be selected. If all are desired, the **Select All** button can be used. Once selections are made, click the **Add Values** button. If the **Add Values** button is not clicked, no values for plotting are added. Thus, multiple values from the items on the left (Entity, Resource, etc.) can be added to the trace before clicking **OK**. Note that statistics do not have to be collected on the values selected for the values to plot.

The custom plot below plots three values: two Entity and one Activity. Hardware Sales and Software Sales are Entities. The value Entities In System is being plotted for both. Sales Process is a Process. The value Number Entities In Process is being plotted for it. All three of these values have the same units (number). Only a trace plot is defined. Following the dialog is the actual plot.






## Removing Values From Custom Plots

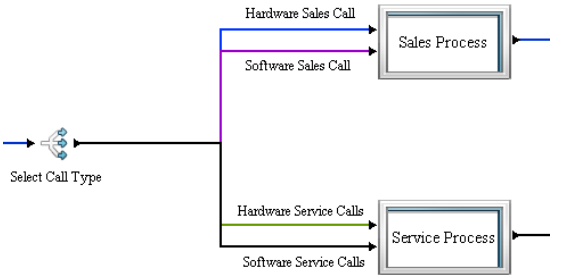
Removing values from a custom plot is accomplished from the Custom Plot Properties dialog. There are two buttons for removing values: **Remove** and **Remove All**. The **Remove All** button clears the plot of all values. The **Remove** button clears the values that have been selected. More than one value can be selected by holding down the Control key when selecting.

## Setting and Removing Plot Group

Custom plots can be assigned to groups. Groups are based on Activities and Processes. A plot can be assigned to any group but can only belong to one group. Plot groups only apply to custom plots or Activity/Process plots from **Real-Time Plots** (**Activities** tab) on the **Report** menu. (See "Real-Time Plots" on page 259.)

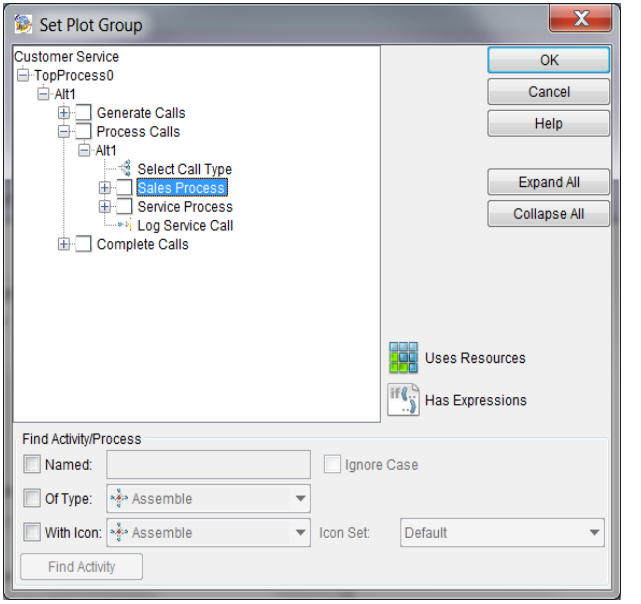
### Setting Plot Group

Plot groups allow custom plots to be associated with a particular Process or Activity, and they limit the number of plots in the **Display Real-Time Plots** dialog. The latter can be valuable if there are many custom plots and/or Activity plots defined in a model. **Display Real-Time Plots** on the **Report** menu or the tool bar brings up a dialog that lists all of the hidden plots in the model. This list can be restricted by assigning custom plots to groups. For instance, below is a portion of a model that models hardware and software sales and hardware and software service. There are two subprocesses: Sales Process and Service Process.



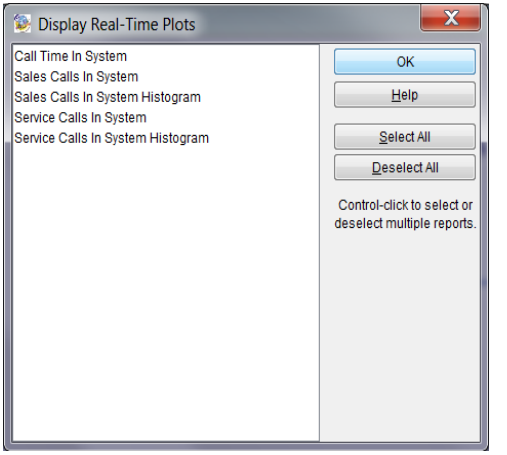

Plots can be assigned to these Processes so that, when one of the Processes is selected, only the plots assigned to its group appear when **Display Real-Time Plots** is selected.

To set the plot group, click the **Set Plot Group** button on the Custom Plot Properties dialog. This opens a dialog that has the hierarchical view of the Activities and Processes in the model (similar to the Activity Browser dialog from the **Edit** menu). The item selected when **OK** is clicked is the group to which the plot is assigned. Plots cannot be assigned to the model, TopProcess, or a Process alternative. If one of those is selected when **OK** is clicked, the plot is not assigned to a group.

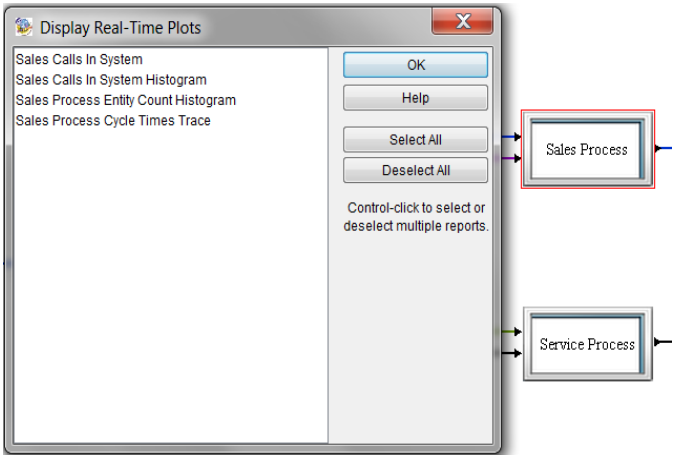



As an example, all the plots chosen to be hidden in the Customer Service model are shown below. This

list was displayed after the model was run using the Display Real-Time Plots button on the tool bar.

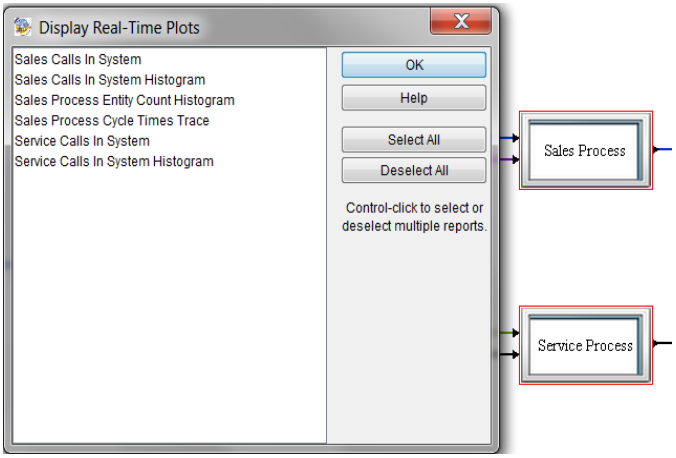



By selecting the Sales Process, this list can be restricted to the plots in the Sales Process group.




The list includes two custom plots (Sales Calls In System Trace and Sales Calls In System Histogram) and two Activity plots from **Real-Time Plots** on the **Report** menu (Sales Process Entity Count Histogram and Sales Process Cycle Times Trace).

Selecting the Sales and Service Processes causes the list to include plots assigned to both Processes.



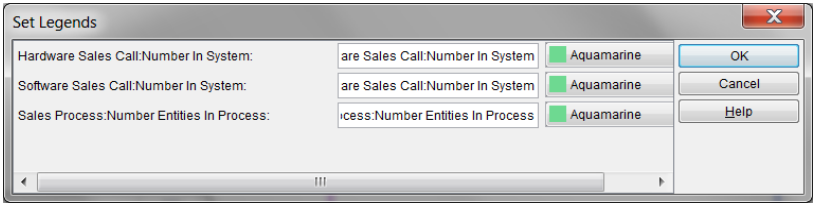

### *Removing Plot Group*

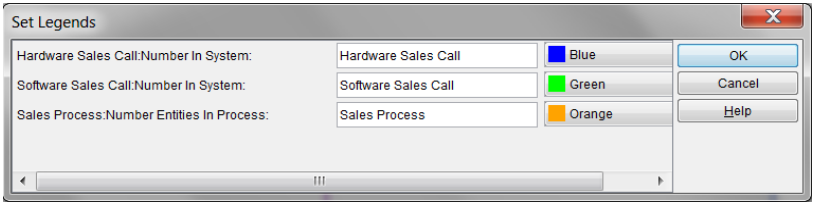
A plot can be removed from a plot group by either changing the assignment using the **Set Plot Group** button or using the **Remove Plot Group** button on the Custom Plot Properties dialog. The **Remove Plot Group** button simply removes the plot from the group, and no reassignment occurs. The button does nothing if the plot is not assigned to a group.

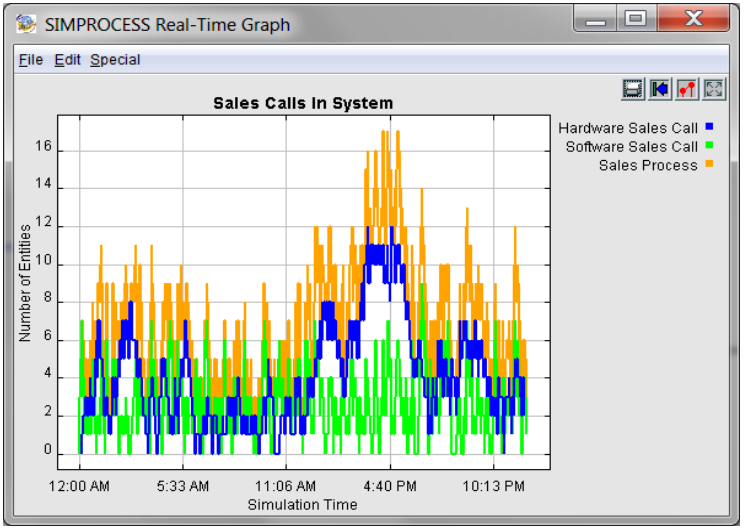
## *Setting Legends*

The legends on custom plots default to the names of the values in the plot (for instance, Software Sales Calls:Entities In System). The **Set Legends** button allows the legend title to be changed. Also, the color of the trace line can be changed. When one or more values in the custom plot have been selected, the **Set Legends** and **Reset Legends** buttons become active. The **Select All** button selects all values in the custom plot, and the **Deselect All** button deselects all values in the custom plot.

The **Set Legends** button brings up a dialog in which the text of the legend and the color of the trace line can be set. Only the values selected will be in the dialog. Double clicking on a single value will bring up the dialog with just the options for that value. The color of the value must be set if the text of the legend is set. If not, the color will be Aquamarine, which is the first color in the color list.




The **Reset Legends** button resets the text and color of the legend to its default.

# Expression Plots

Real-time Plots and Custom Plots, once defined, are updated automatically by SIMPROCESS. Also, these plots are reset at the beginning of each replication. There is no way to control when the plots are updated or reset. However, plots can be created and controlled using the SIMPROCESS Expression Language. (See "Customizing a Model with Attributes and Expressions" for more information on Expressions.) Creating and controlling plots through the SIMPROCESS Expression Language allows plotting to be done across replications. Also, this capability allows replication summary statistics to be graphed.

There are five System Methods for plotting listed in "SIMPROCESS System Methods": `CreatePlot`, `AddPlotLegend`, `ClearPlot`, `DisplayPlot`, and `PlotValue`. A discussion of these methods can be found in the section "Creating and Controlling Plots With Expressions". Note that the demonstration model `SplitJoin.spm` that is included with SIMPROCESS has an example of Expression Plots (open model and view **Define/Model Expressions**).

# Simulation Results File

The Simulation Results file is generated from the **File** menu. Select **File/Export/Simulation Results** to open the **Save Statistics** dialog. The Simulation Results file will, by default, have an `.xpt` file extension and be saved to the current model directory. This file is tab-delimited and can be opened using a text editor or spreadsheet.

The file will contain the complete statistical measures corresponding to the reports selected for the current model. This file contains raw statistical data that is displayed in the Standard and Custom Reports in a standard format that can be opened by many different applications.

For a complete listing of the format of the Simulation Results file, see "Simulation Results File"

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